Population Synthesis & Forecasting

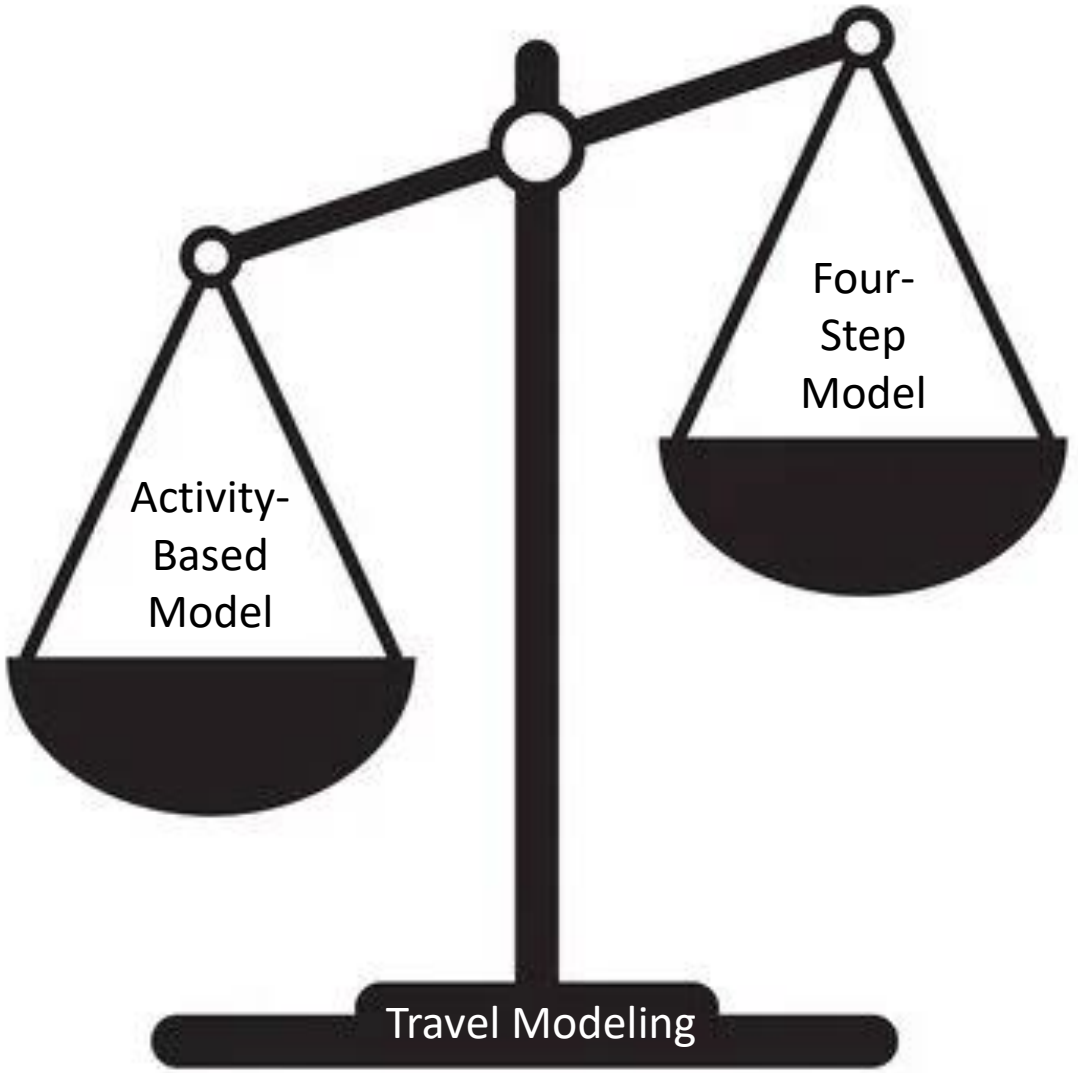
Presenter: Ibrahim Itani Ph.D.

Date: September 25th, 2024

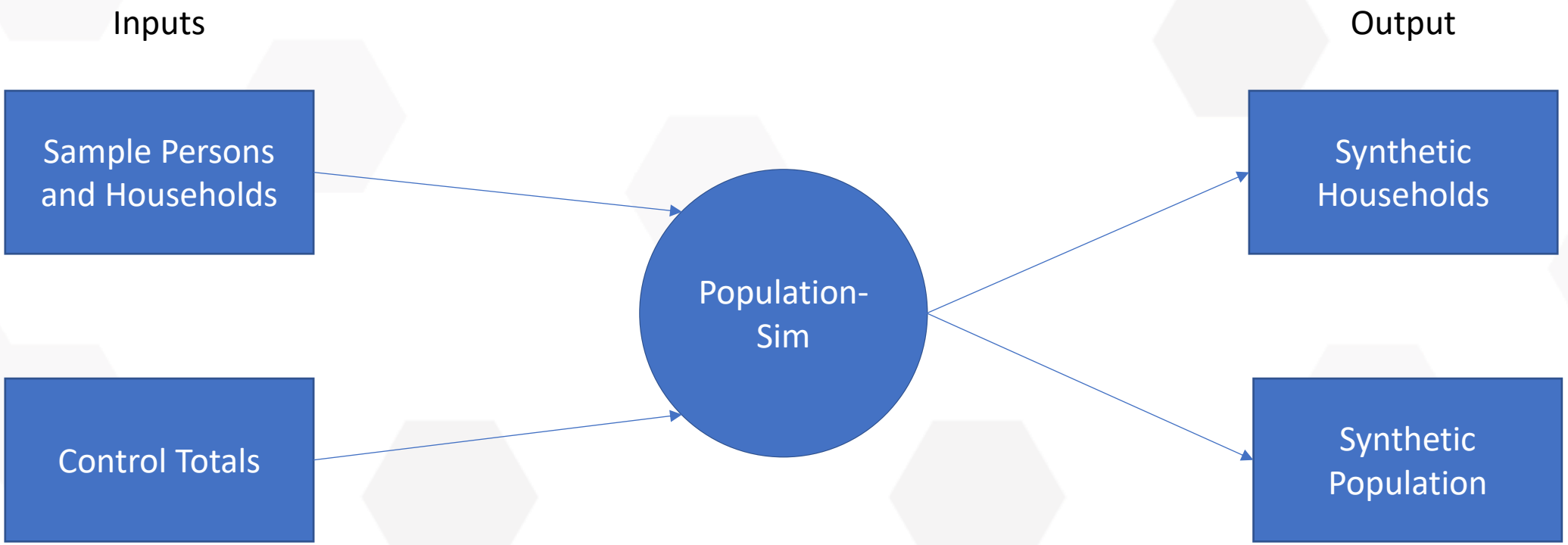
Outline

- Why synthesize?
- Population Synthesis Process
- Population Forecasting Process
- ReGEN: A new land use updating tool
- Questions

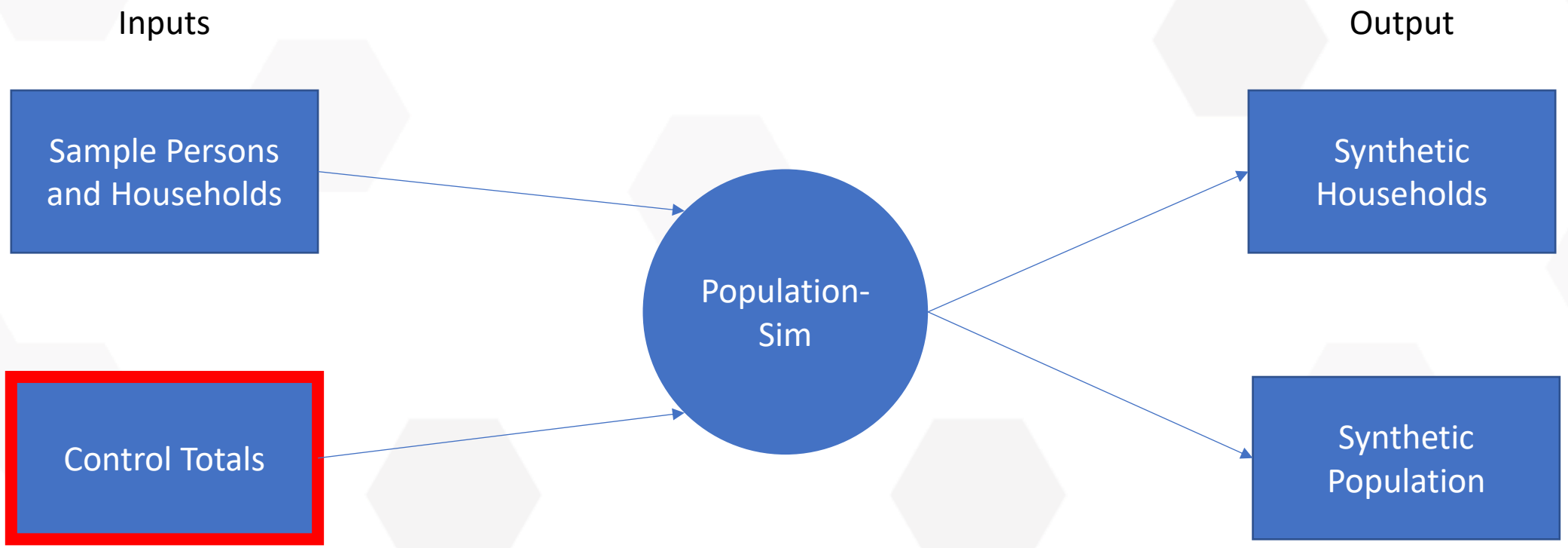
Why Synthesize?



Population Synthesis Process



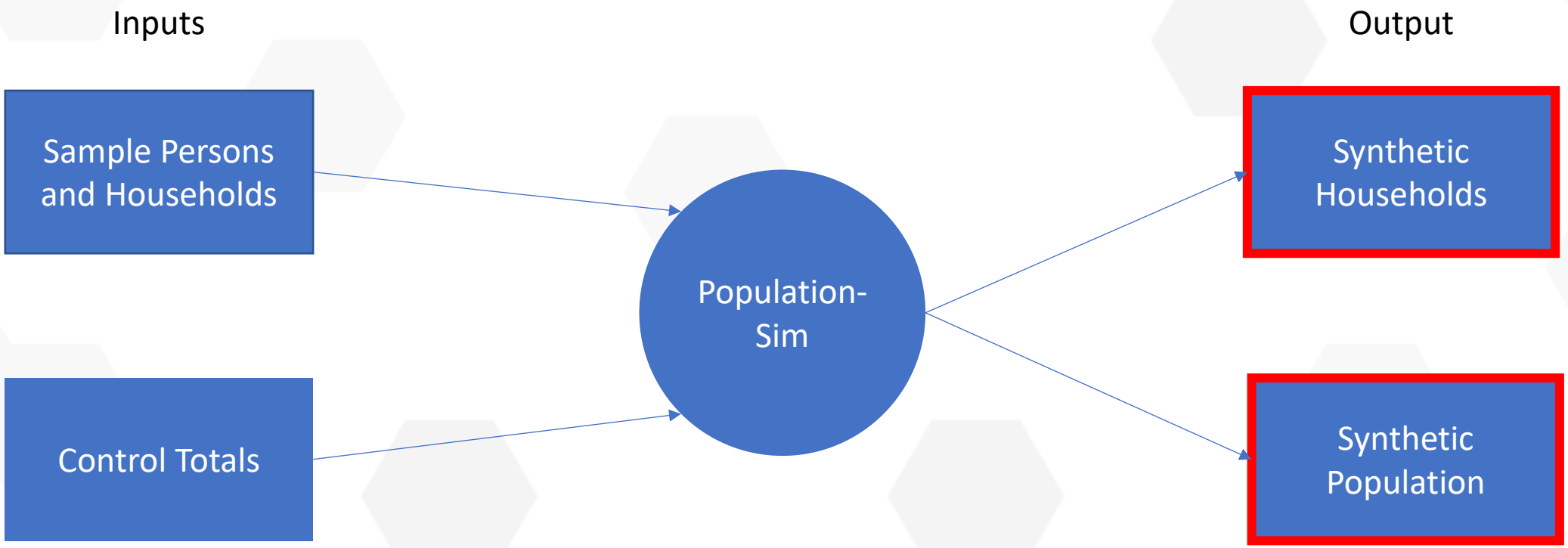
Population Synthesis Process



Control Table Example

BLOCKGROUP	hhbase	pbase	hh_size_1	hh_size_2	hh_size_3	hh_size_4	hh_size_5_plus
30601002	637	1684	165	248	55	112	57
30603001	320	1000	116	58	55	16	75
30606001	617	1543	116	350	33	69	49
30701001	835	2503	32	423	134	171	75
30706001	700	2008	205	197	99	97	102
30706004	502	1546	36	213	53	160	40
30709003	511	1577	79	258	35	33	106
30710003	654	1524	110	360	77	90	17
30711003	1077	3204	252	243	328	108	146
30809002	303	760	88	101	41	55	18
30810003	612	1540	149	278	58	79	48
30812002	794	2437	154	284	139	83	134
30901002	441	1395	67	105	136	76	57
30902003	668	1465	126	363	135	34	10
31000003	938	2318	174	381	208	156	19

Population Synthesis Process



Synthesized Results Example

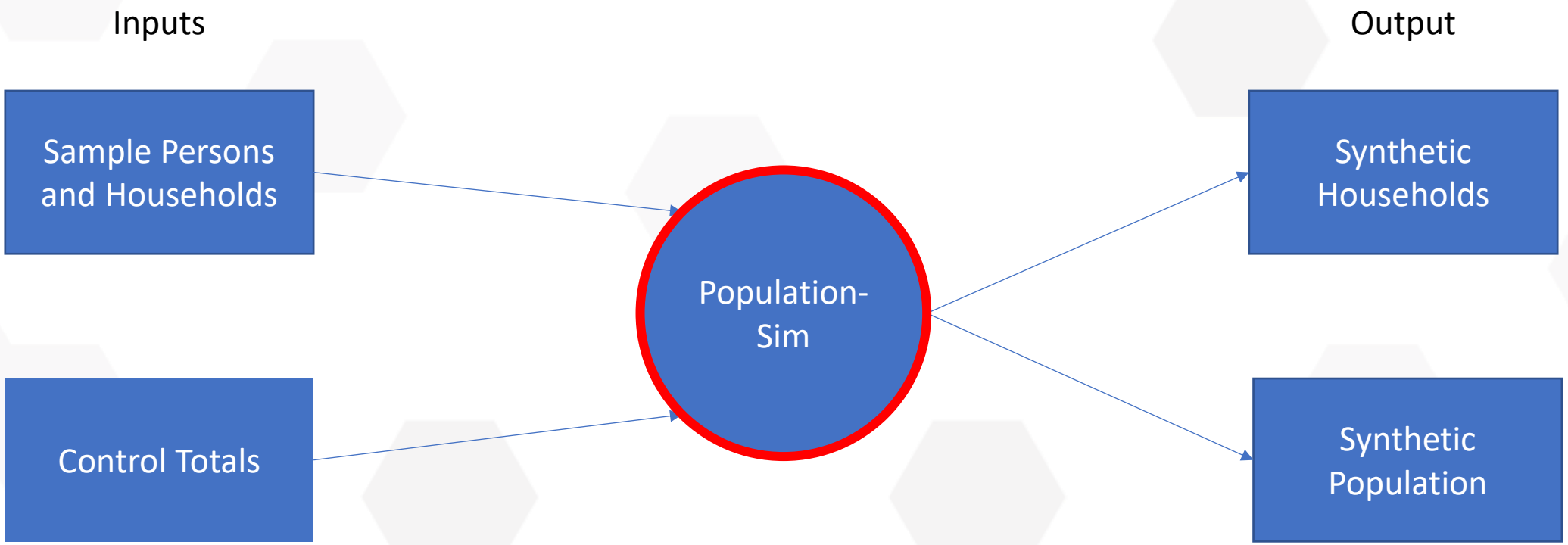
household_id	PUMA	TRACT	BLOCKGROUP	PSEUDOTAZ	NP	AGEHO	HINCPADJ	BLD	TEN	NPF	NOC	VEH	HINCPADJ2000	NWORKERS	NSTUDENT	UNIV
1	1700	8602	8602001	1789000	2	68	52060	2	2	2	0	2	33084	0	0	0
2	1700	8602	8602001	1789000	4	42	84339	2	1	4	2	3	53597	2	1	0
3	1700	8602	8602001	1789000	4	32	85100	3	3	0	0	2	54081	4	0	0
4	1700	8602	8602001	1789000	2	85	33040	2	2	2	0	2	20997	0	0	0
5	1700	8602	8602001	1789000	2	77	22172	2	2	2	0	2	14090	0	0	0
6	1700	8602	8602001	1789000	3	26	76732	1	3	2	1	1	48763	1	1	0

Household #2:

- Four-person household
- 42 year old householder
- $84K household income
- Asian Householder
- Owns three cars
- Two workers
- One child attending school

household_id	per_num	ETHN	AGEP	RAC1P	FHISP	SEX
1	1	1	68	1	0	2
1	2	1	80	1	0	1
2	1	4	42	6	0	2
2	2	4	44	6	0	1
2	3	4	16	6	0	1
2	4	4	3	6	0	2
3	1	5	32	8	0	1
3	2	5	44	8	0	2
3	3	5	24	8	0	1
3	4	5	25	8	0	2
4	1	1	85	1	0	1
4	2	1	84	1	0	2
5	1	4	77	6	0	1
5	2	4	72	6	0	2
6	1	5	26	8	0	1
6	2	5	1	8	0	2
6	3	5	22	8	0	2

Population Synthesis Process



Population Synthesis Process

Control Geographies

Tract

TRACT

Population Synthesis Process

Control Geographies

Block Groups

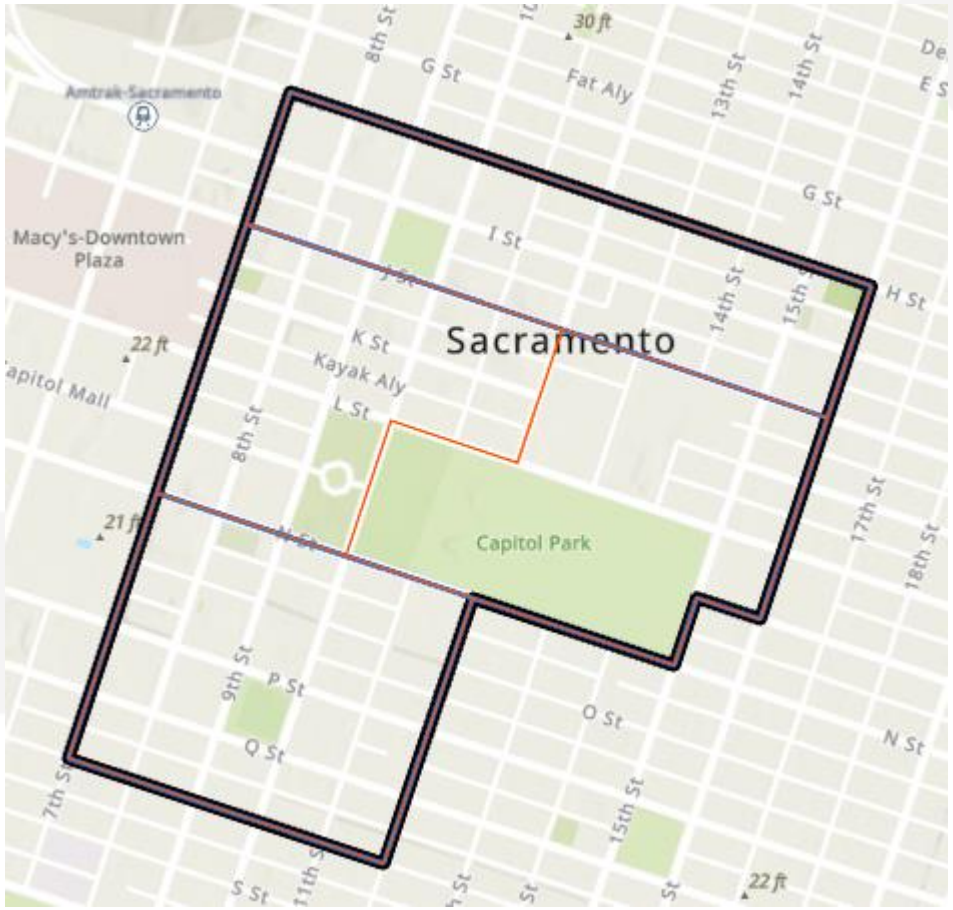
TRACT

Block Group

Population Synthesis Process

Control Geographies

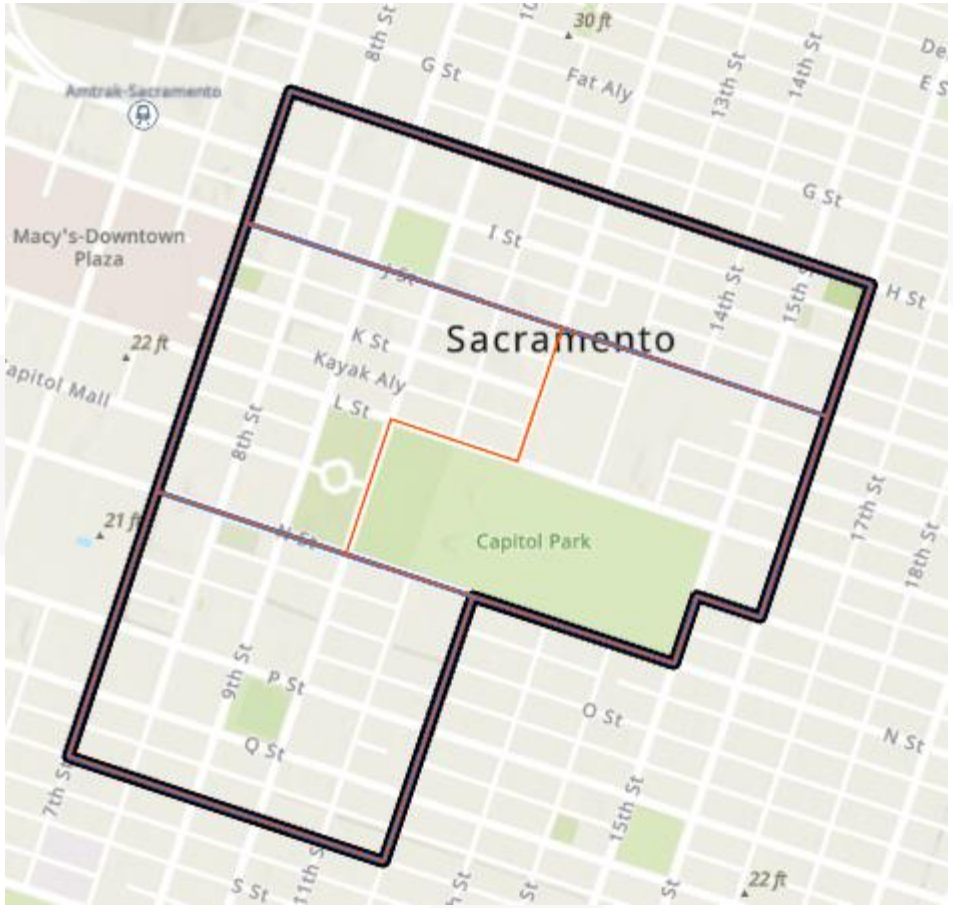
Traffic Analysis Zones



TRACT
Block Group
Traffic Analysis Zone

Population Synthesis Process

Control Geographies



PopulationSim Controls:

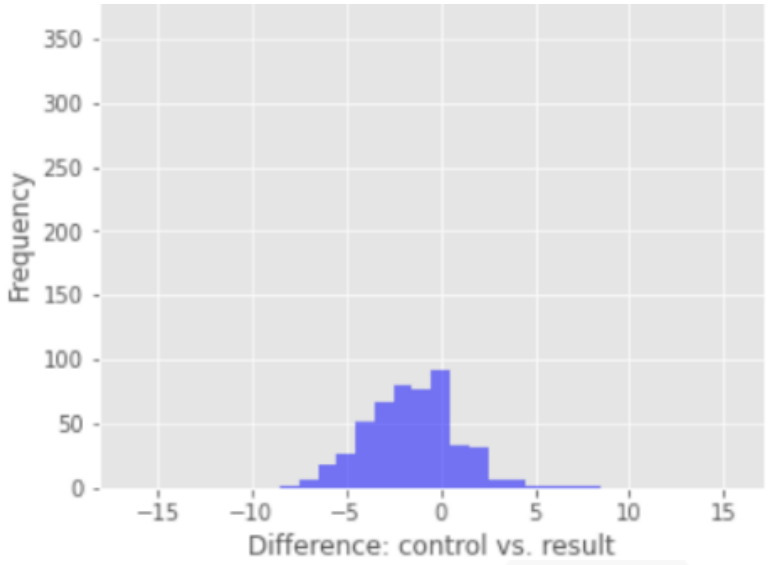
- Number of households
- Number of persons
- Household size
- Number of workers in a household
- Household Income
- Householder age
- Person age
- Person ethnicity

TRACT
Block Group
Traffic Analysis Zone

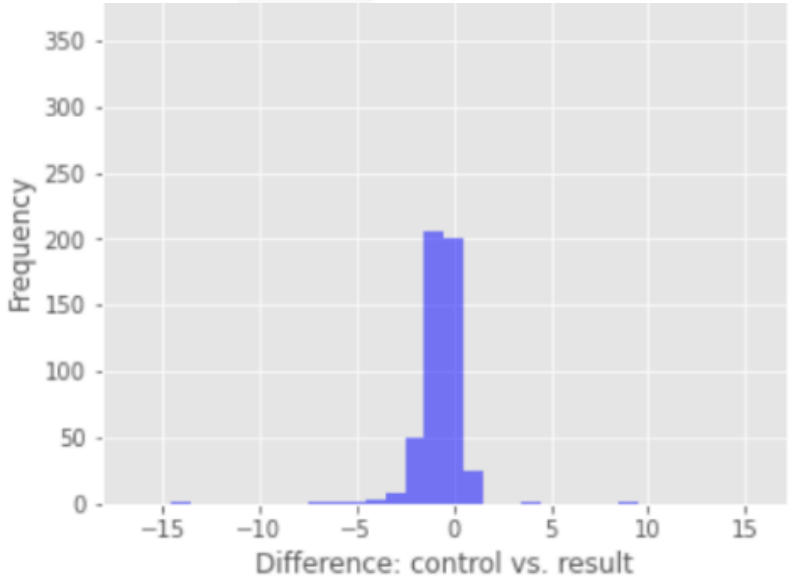
Synthesizer Comparison

Householder Age (0-35) Tract Level Error

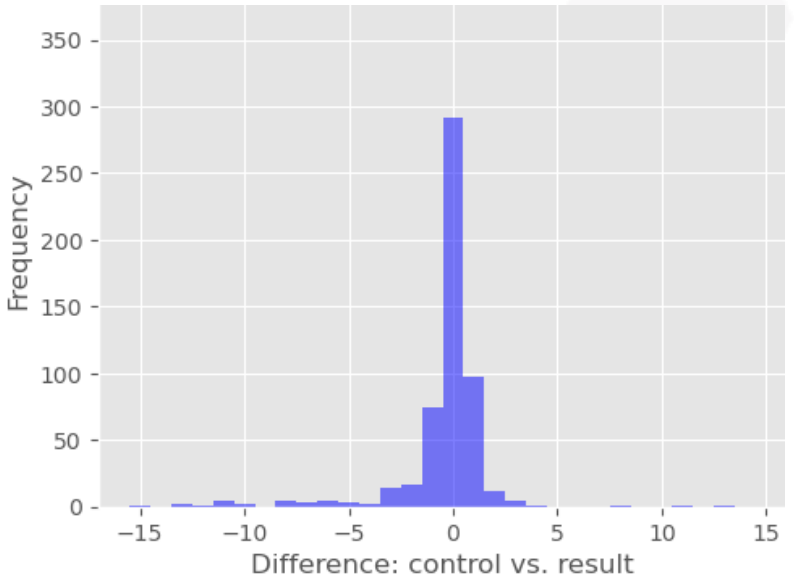
2016 PopGEN Tract Level Control



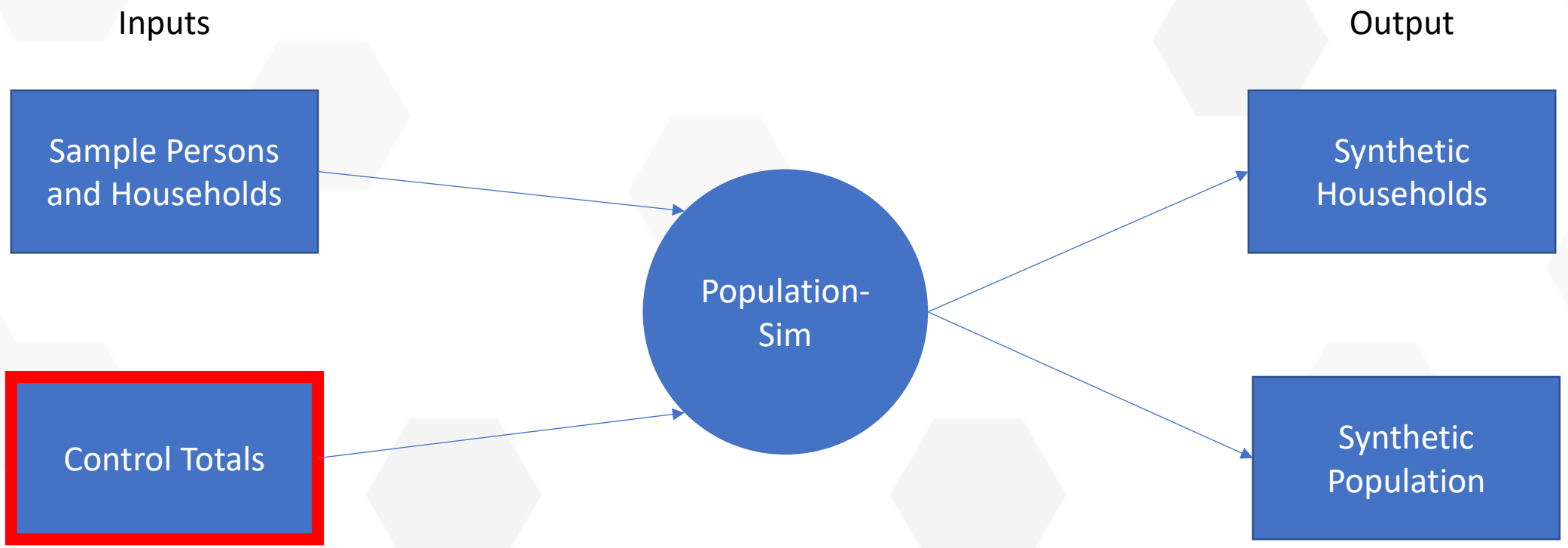
2016 PopulationSim Tract Level Weighted Control



2020 PopulationSim Block Group Level Weighted Control

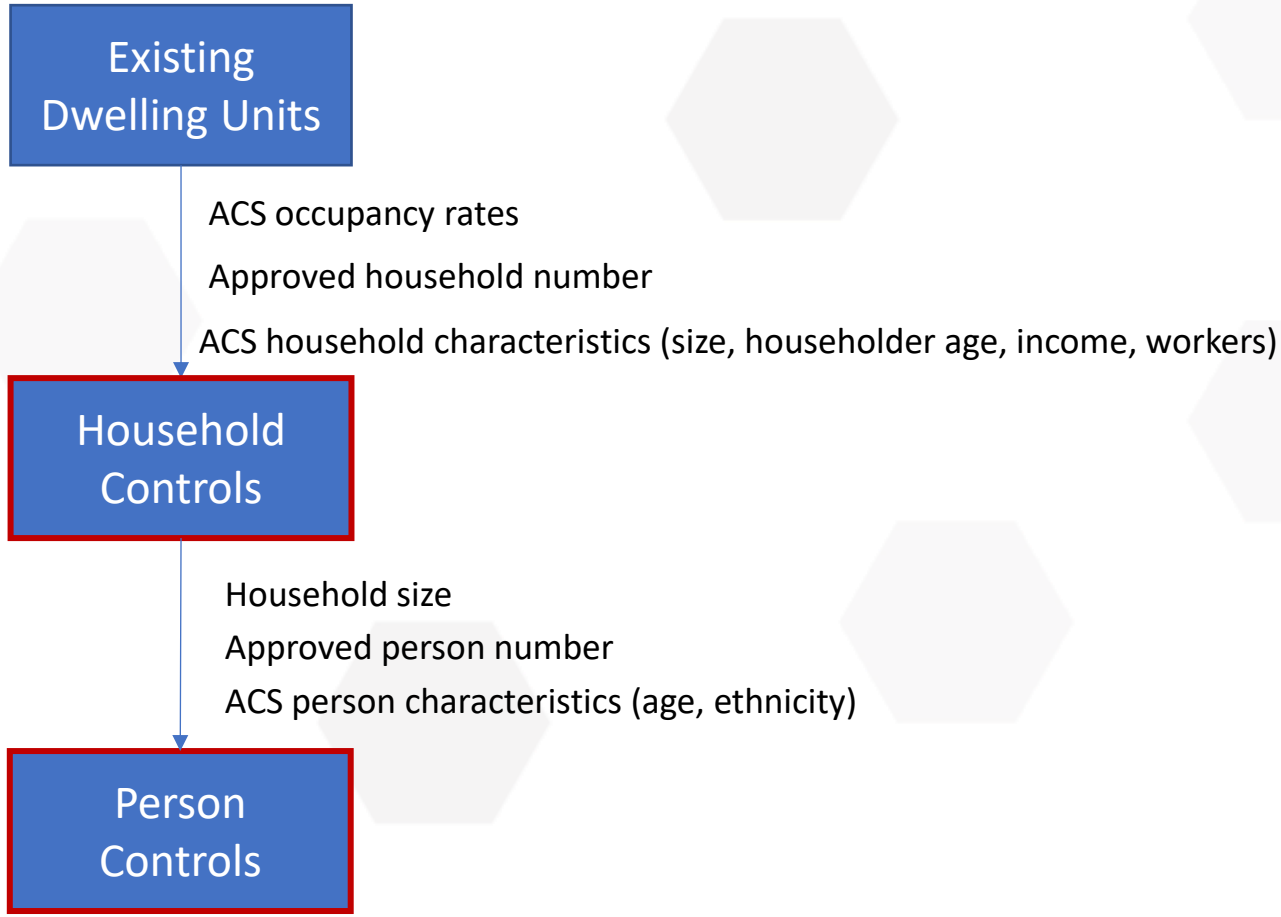


Population Synthesis Process

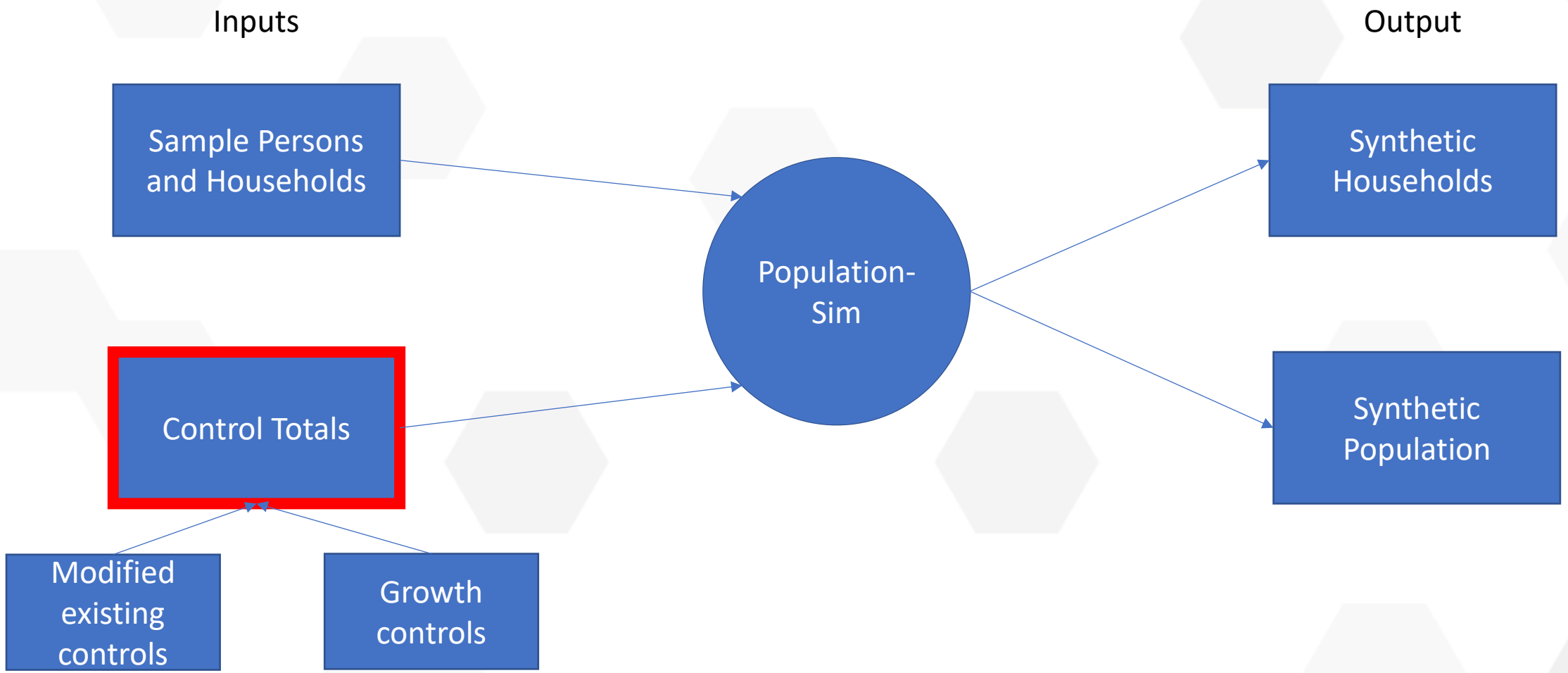


Population Synthesis Process

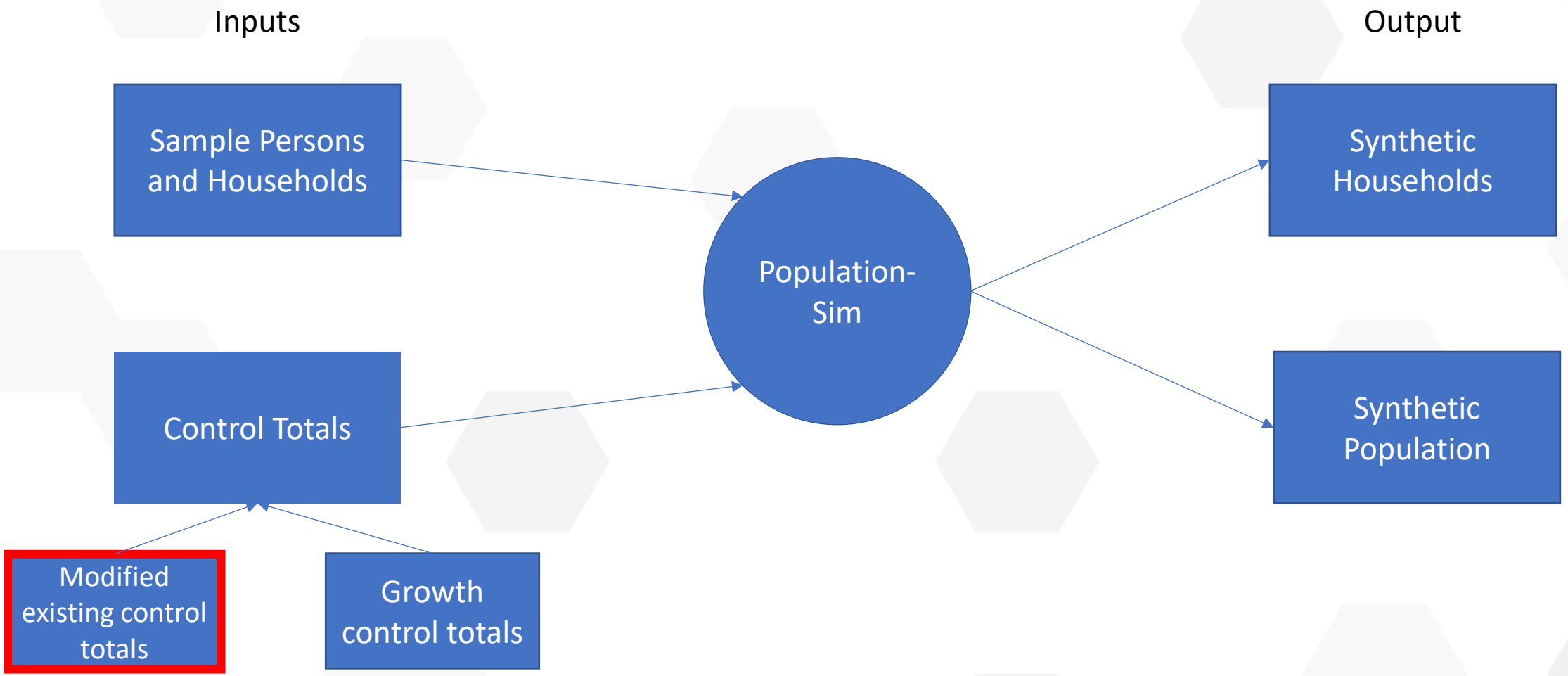
Control Totals



Population Forecasting Process

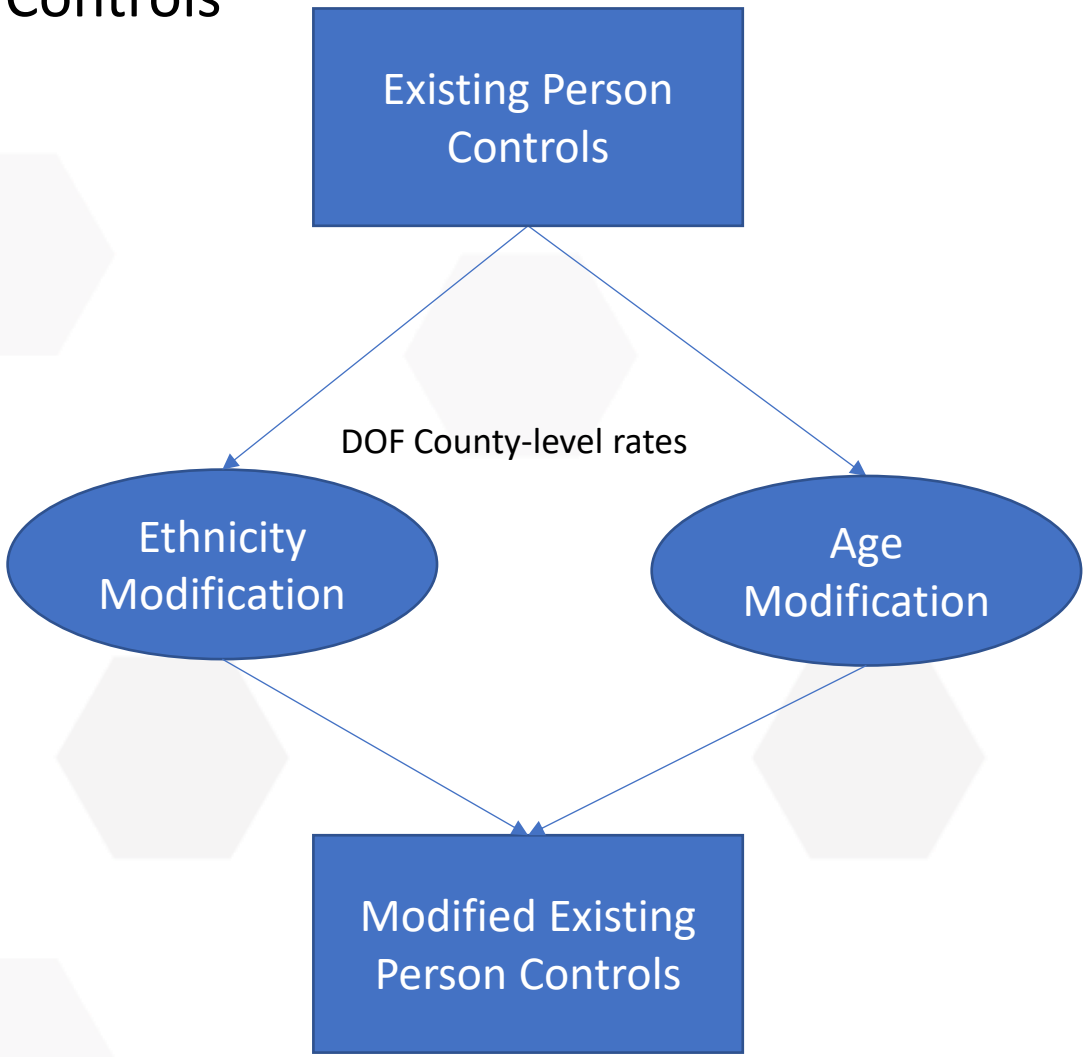


Population Forecasting Process



Population Forecasting Process

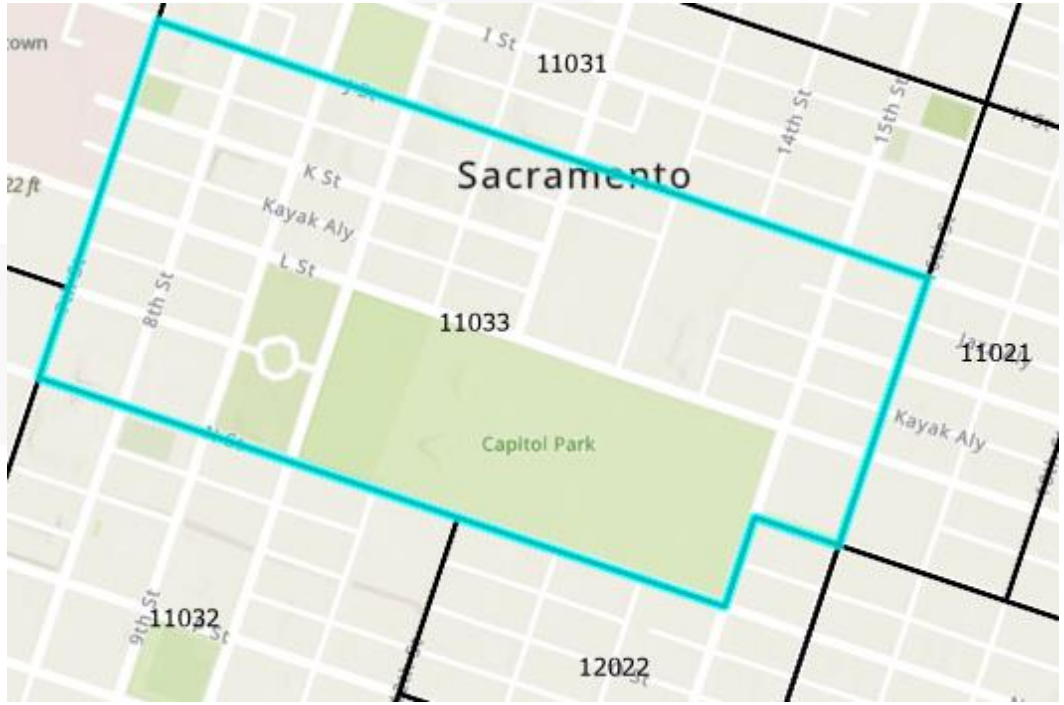
Adjusting Existing Controls



Population Forecasting Process

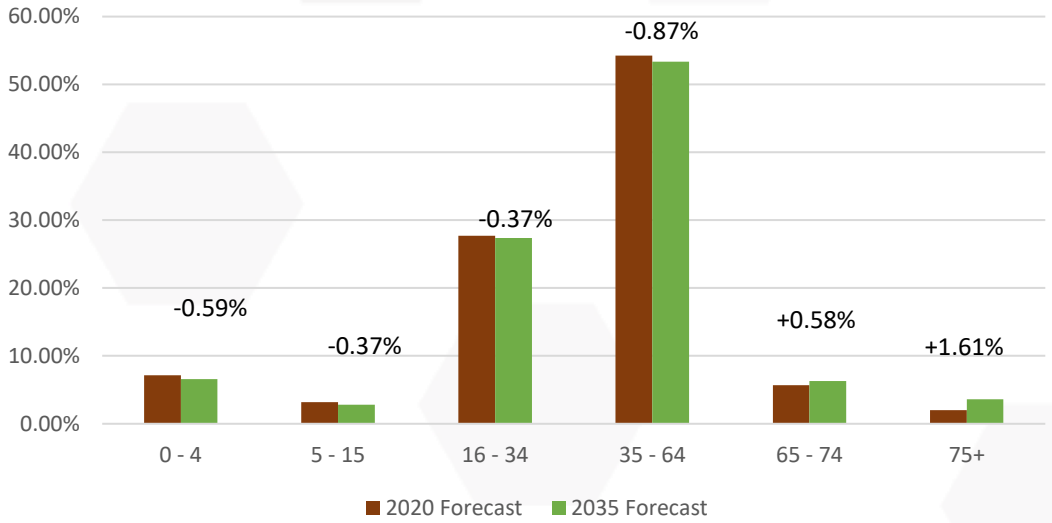
A Tale of Two Block Groups

Sacramento Block Group 11033

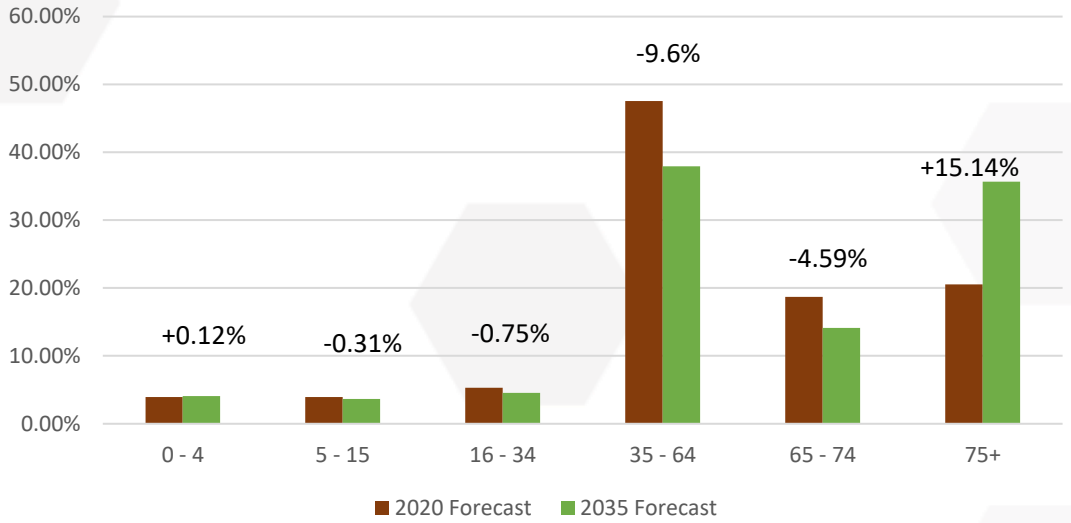


El Dorado Block Group 312002

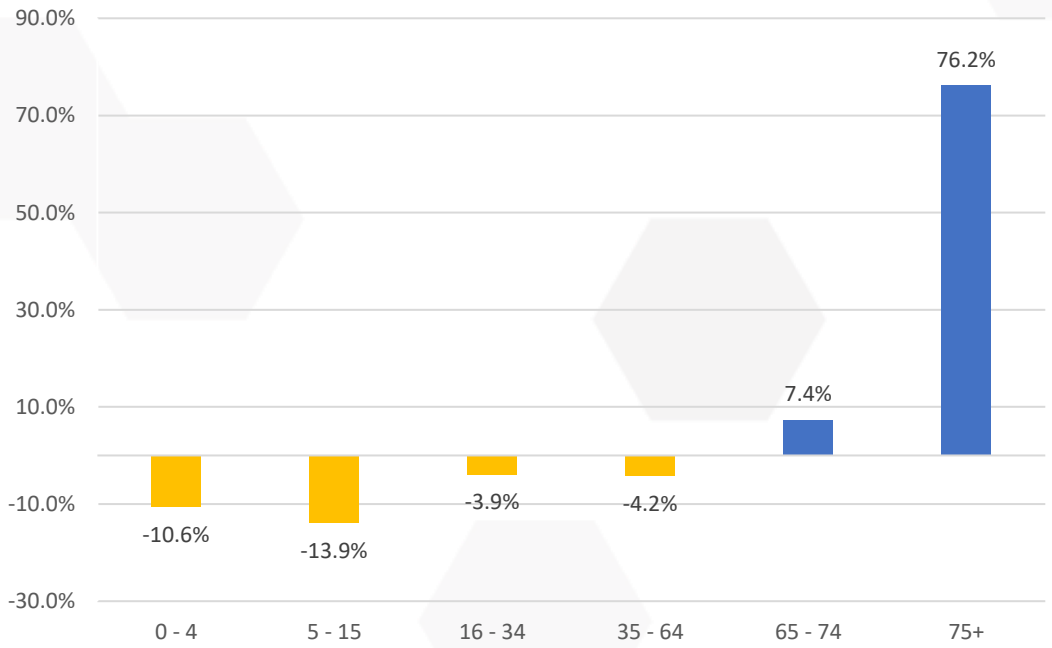
Sacramento Block Group Population by Age in 2020 vs 2035



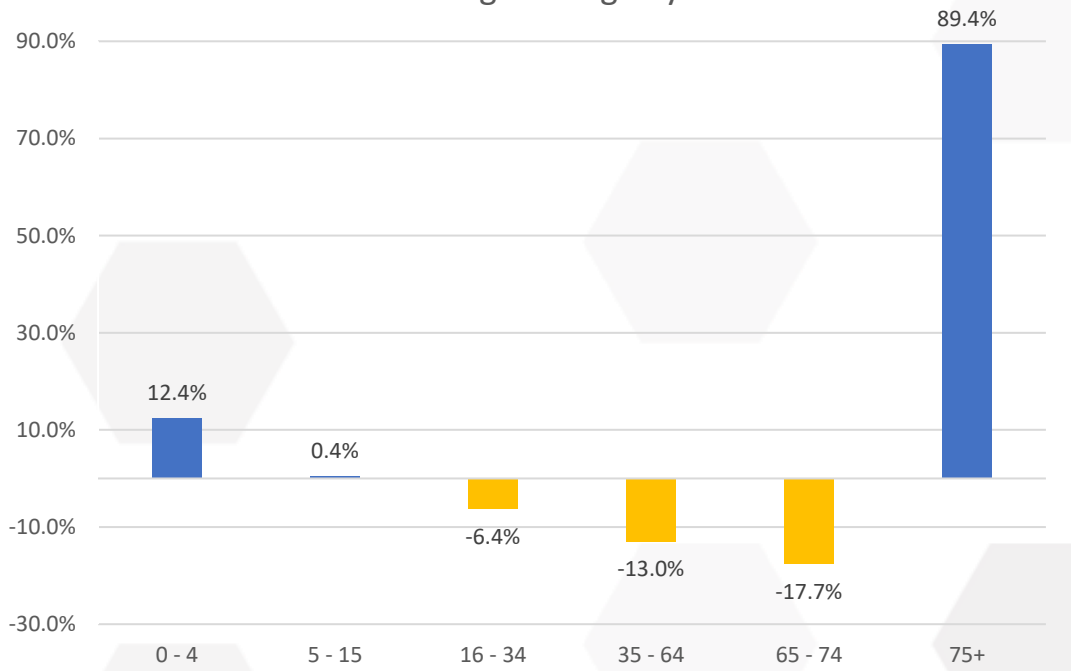
El Dorado Block Group Population by Age in 2020 vs 2035



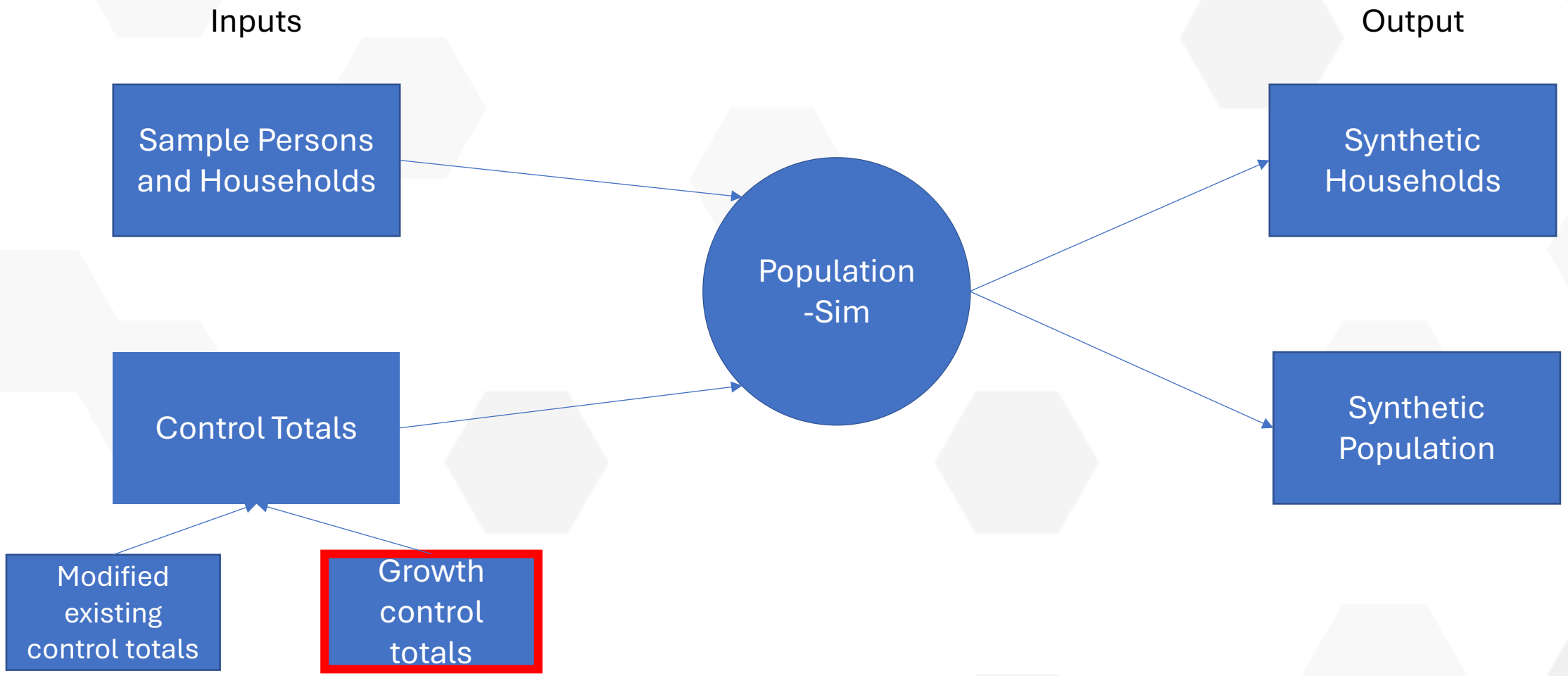
Sacramento Age Change by 2035



El Dorado Age Change by 2035

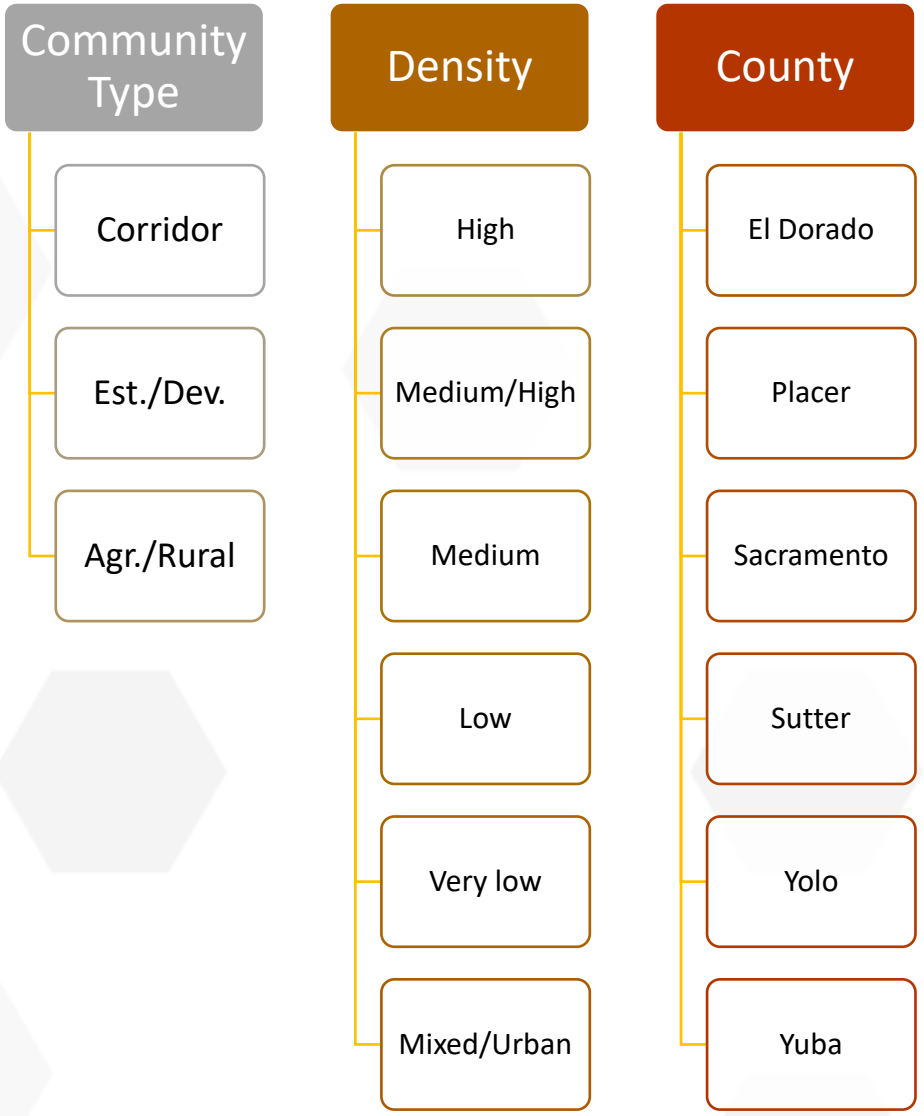


Population Forecasting Process



Population Forecasting Process

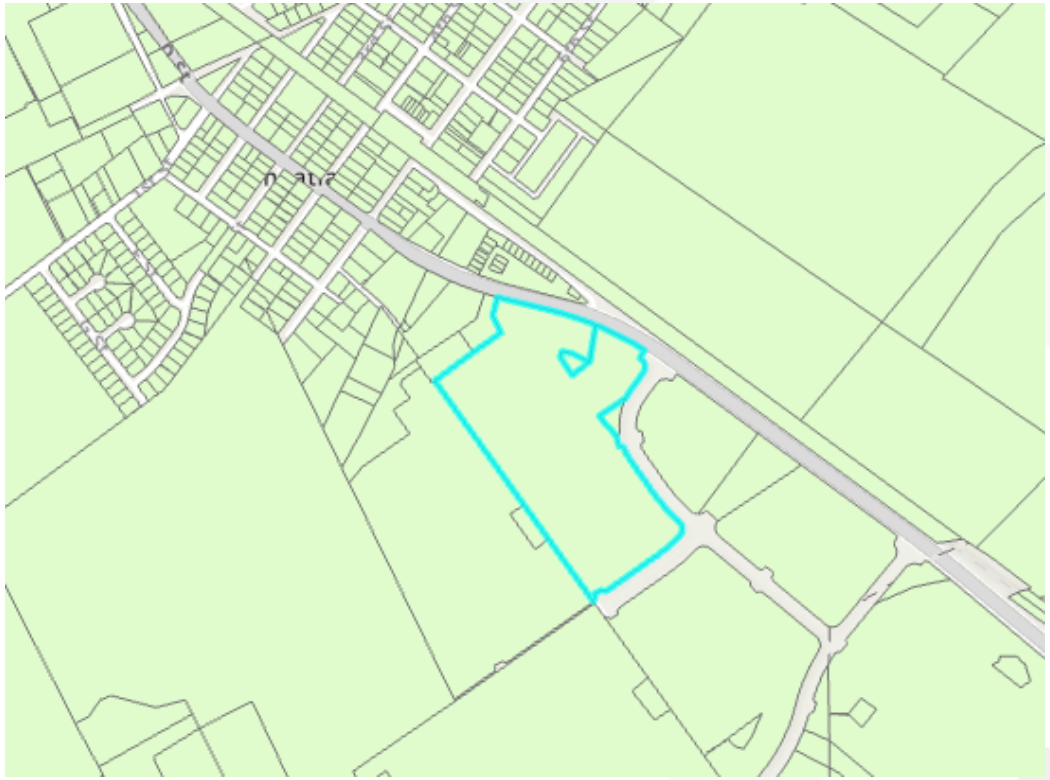
Types of Growth



3x6x6=108 types of new development

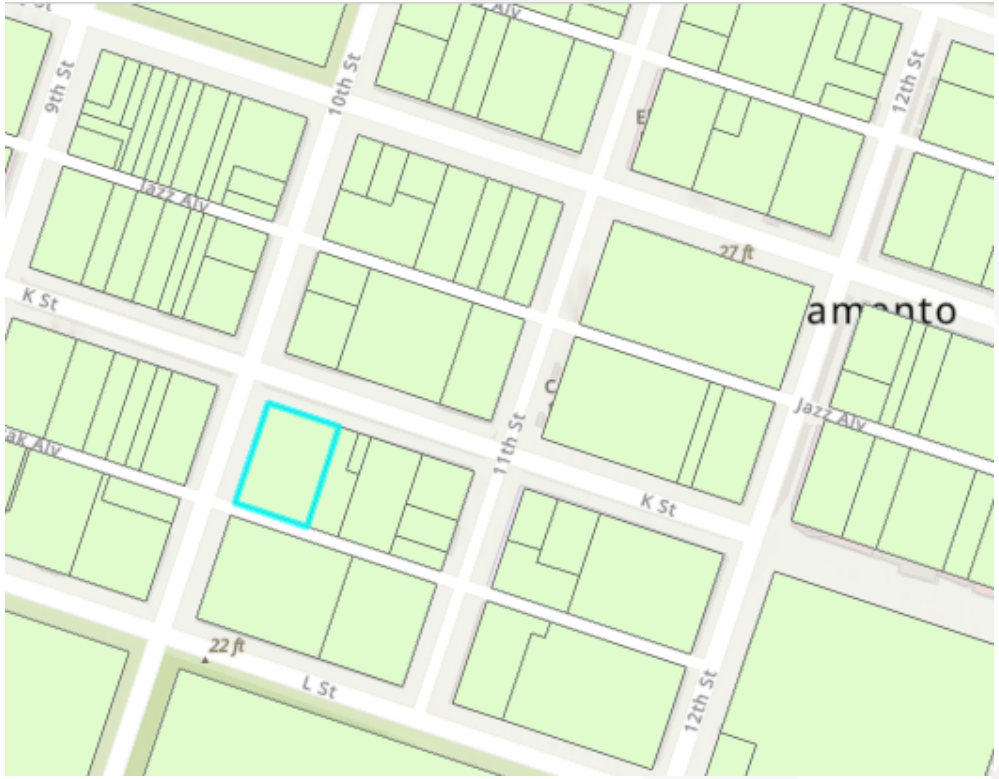
New Development
Community type – Density – County

Developed/Established, Very Low Density Detached Residential, Yuba

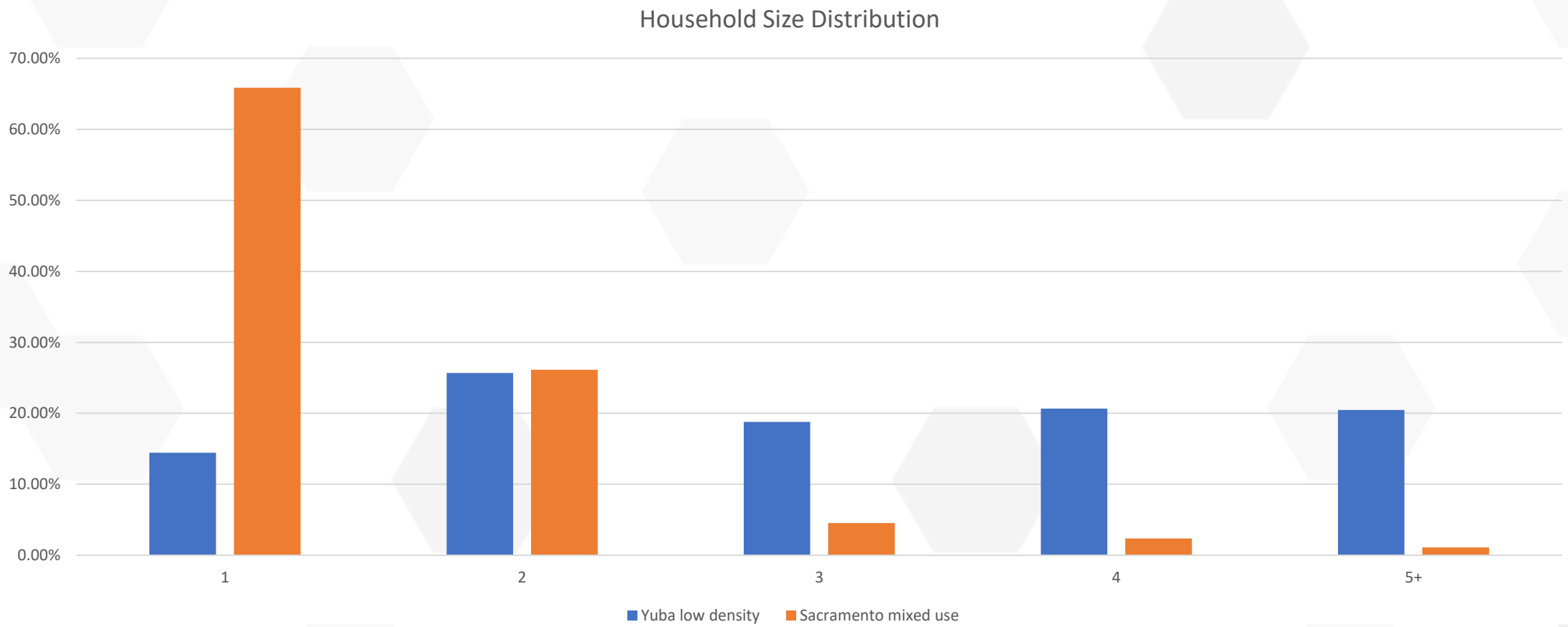


New Development
Community type – Density – County

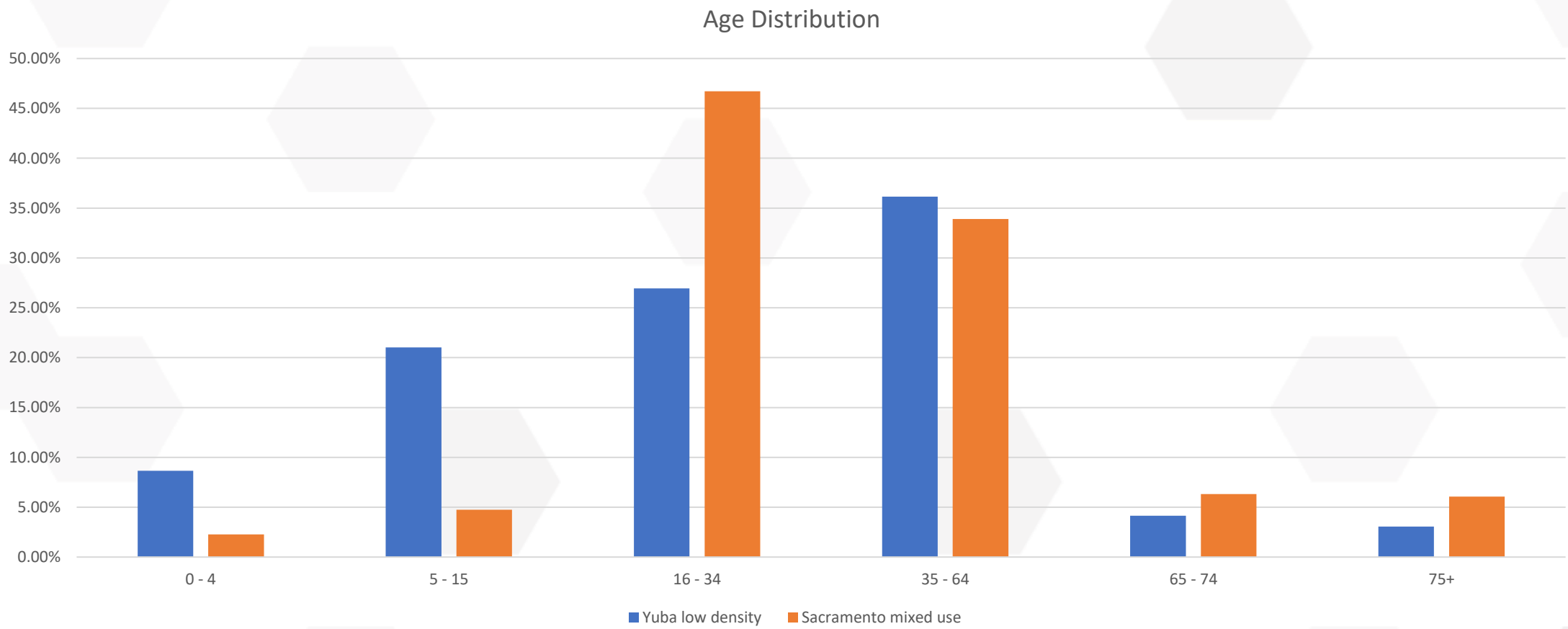
Corridor, Mixed Use, Sacramento



New development household characteristics

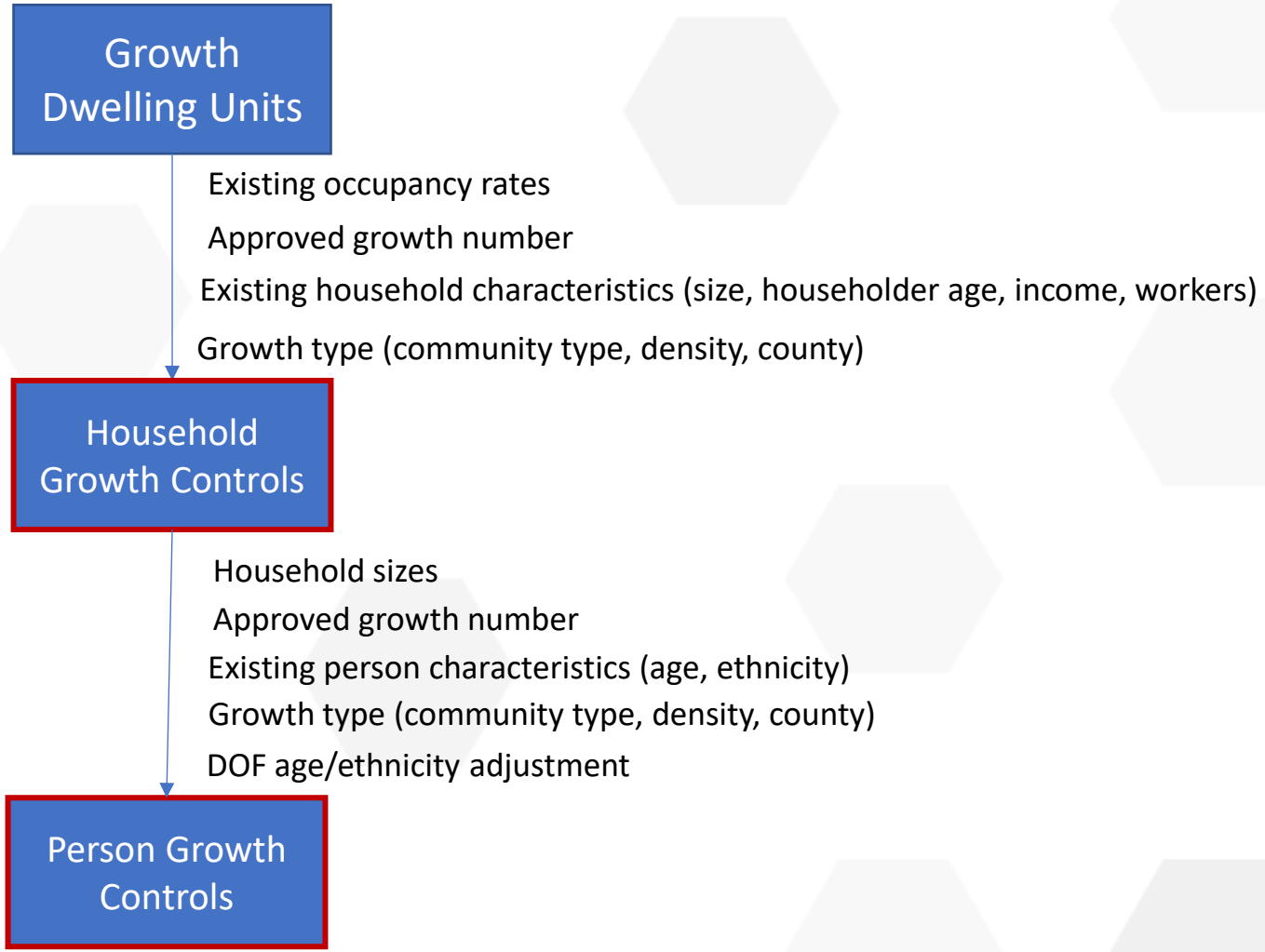


New development person characteristics

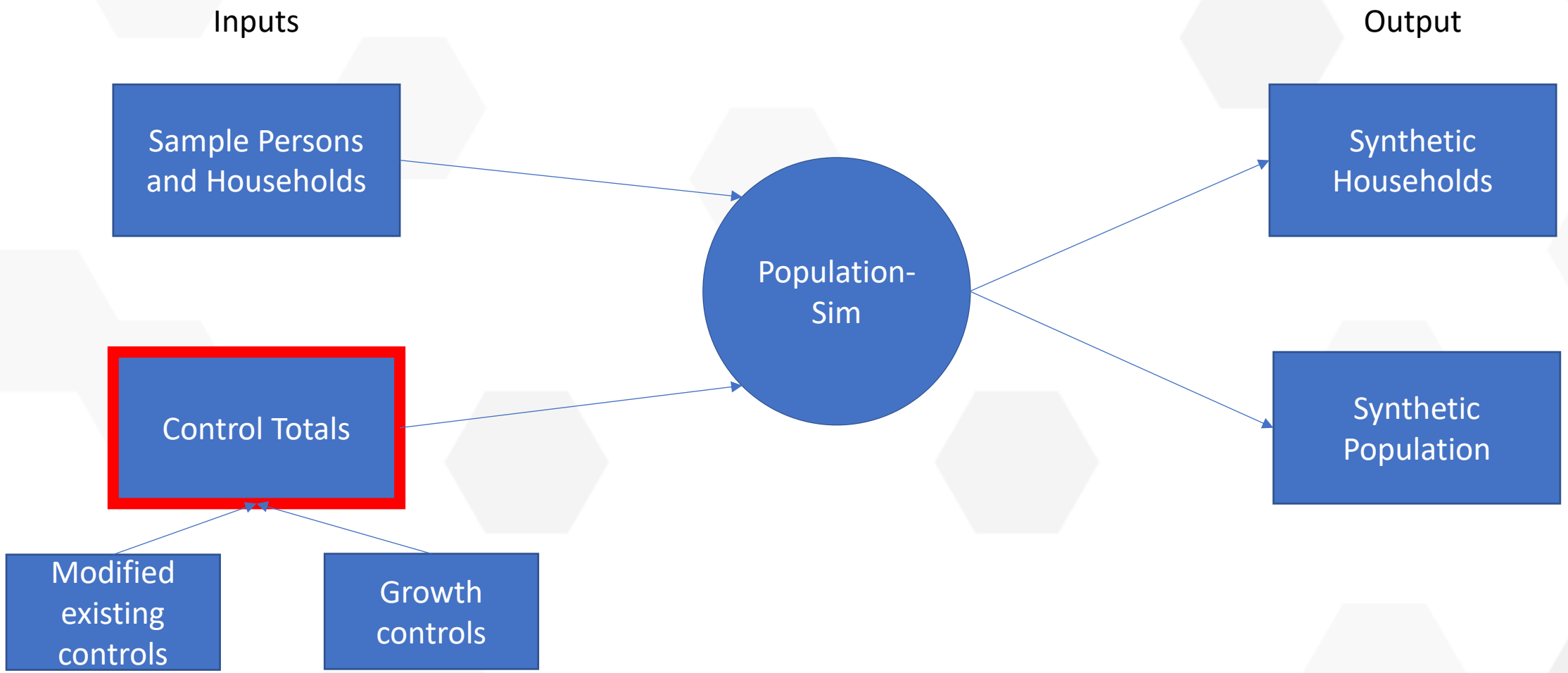


Population Forecasting Process

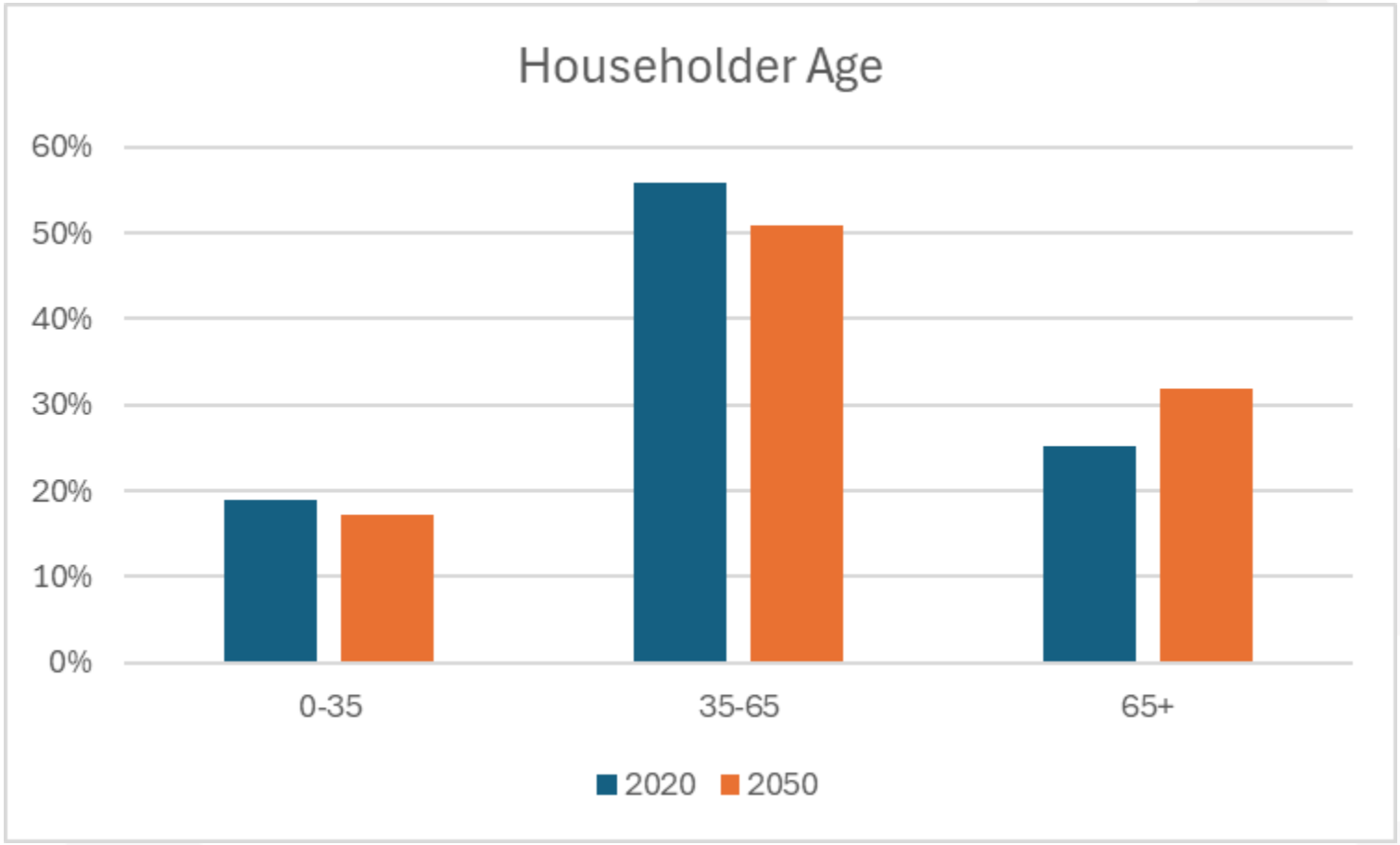
Growth Controls



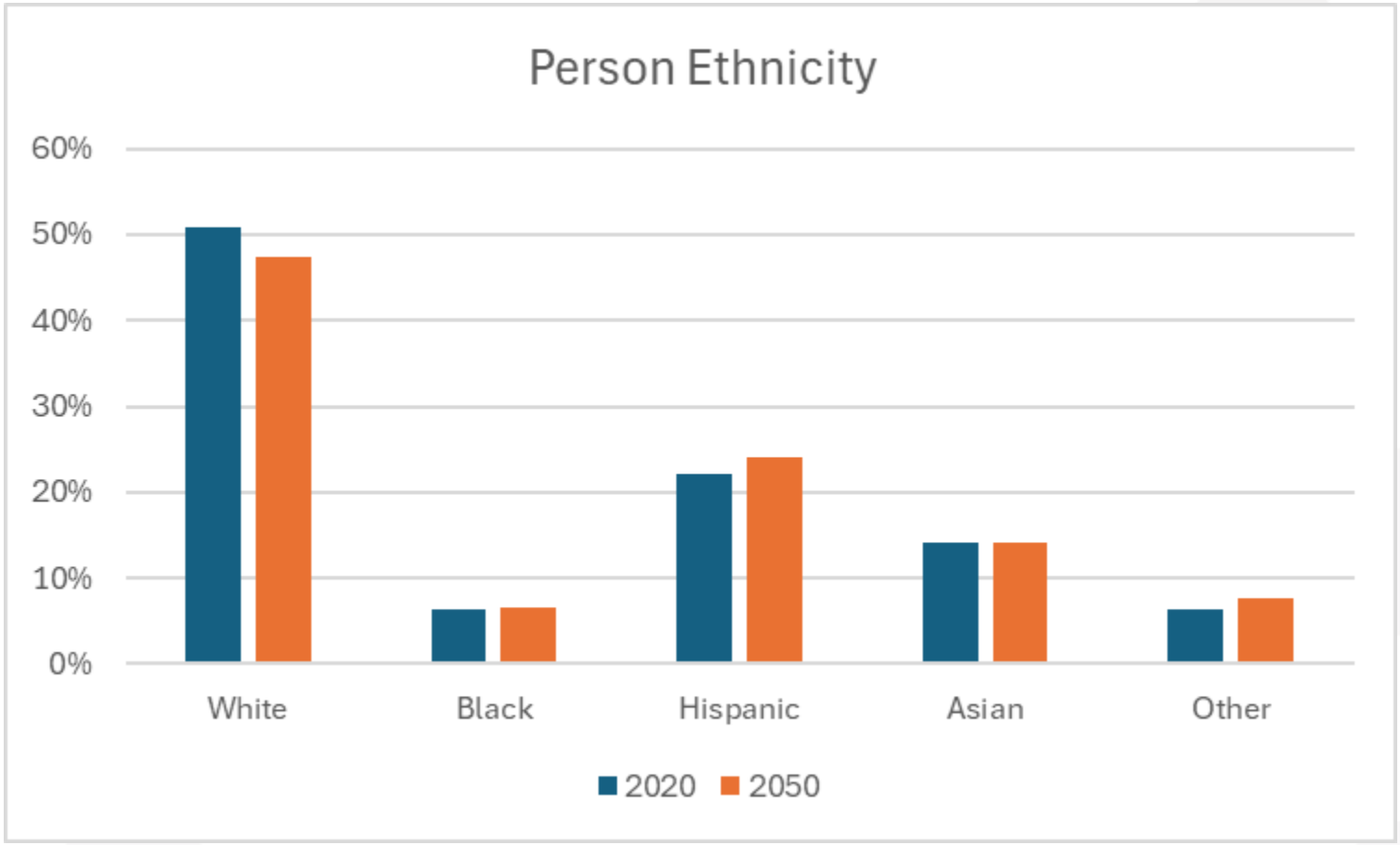
Population Forecasting Process



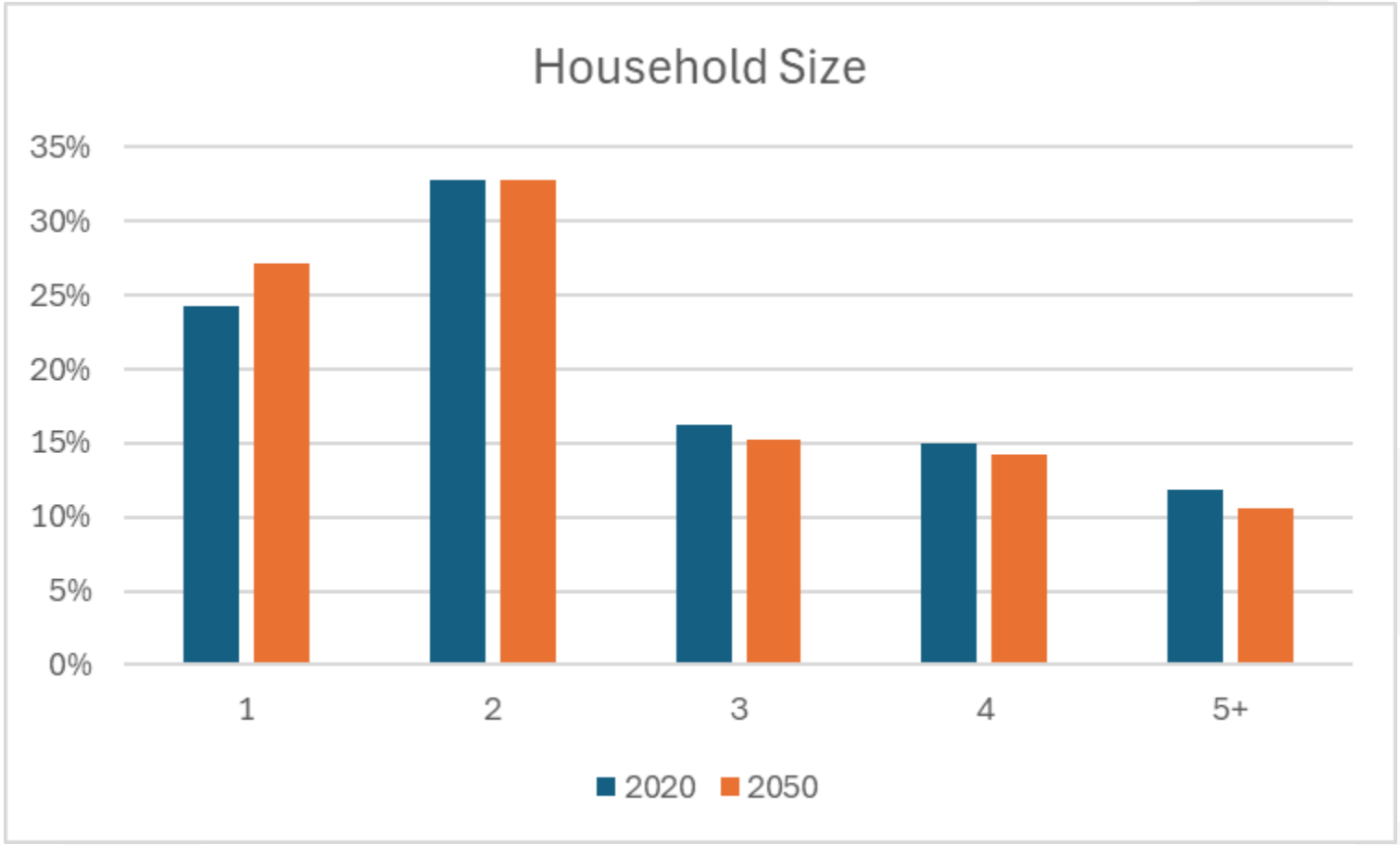
Base-Year vs Future Year Control Splits



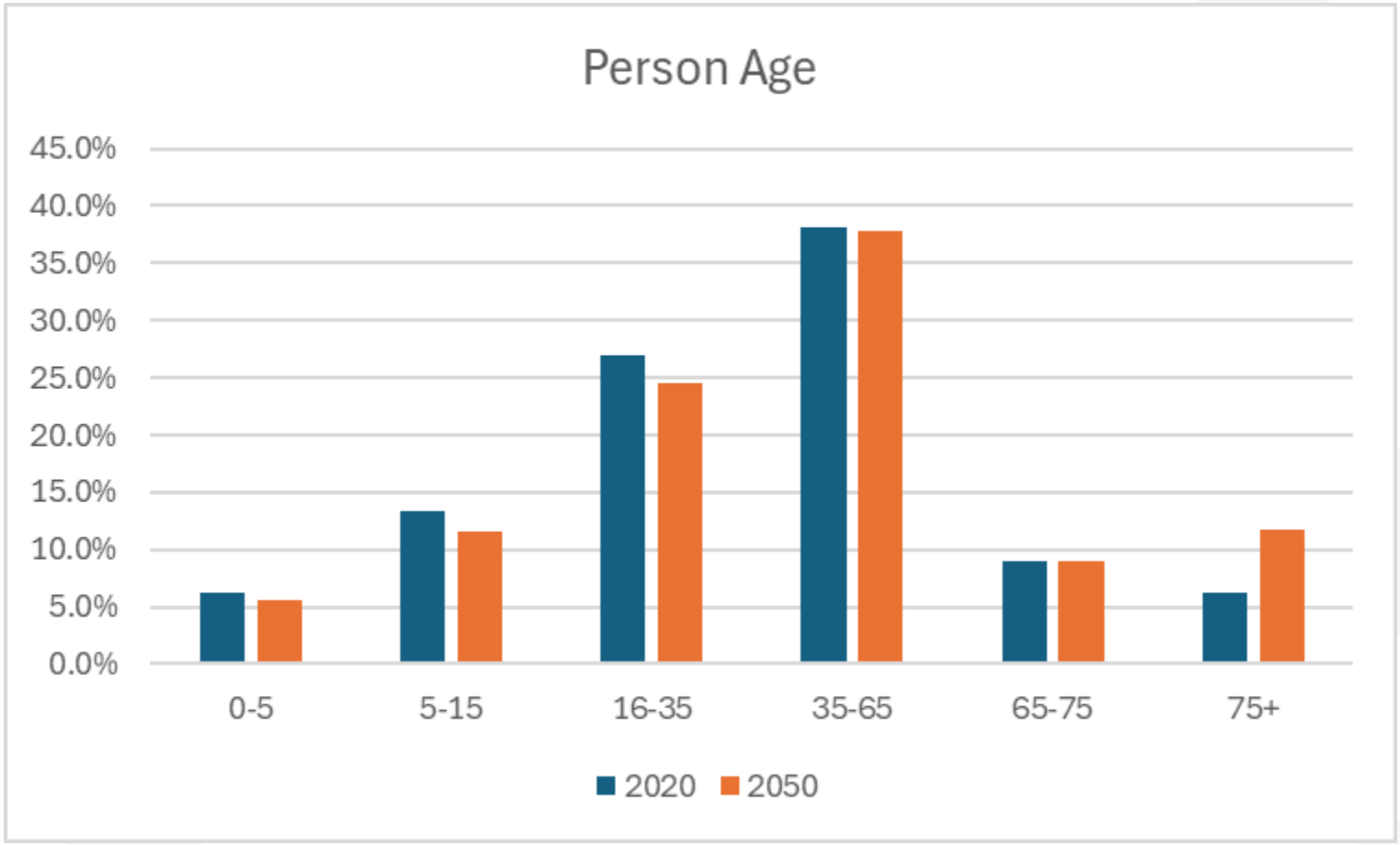
Base-Year vs Future Year Control Splits



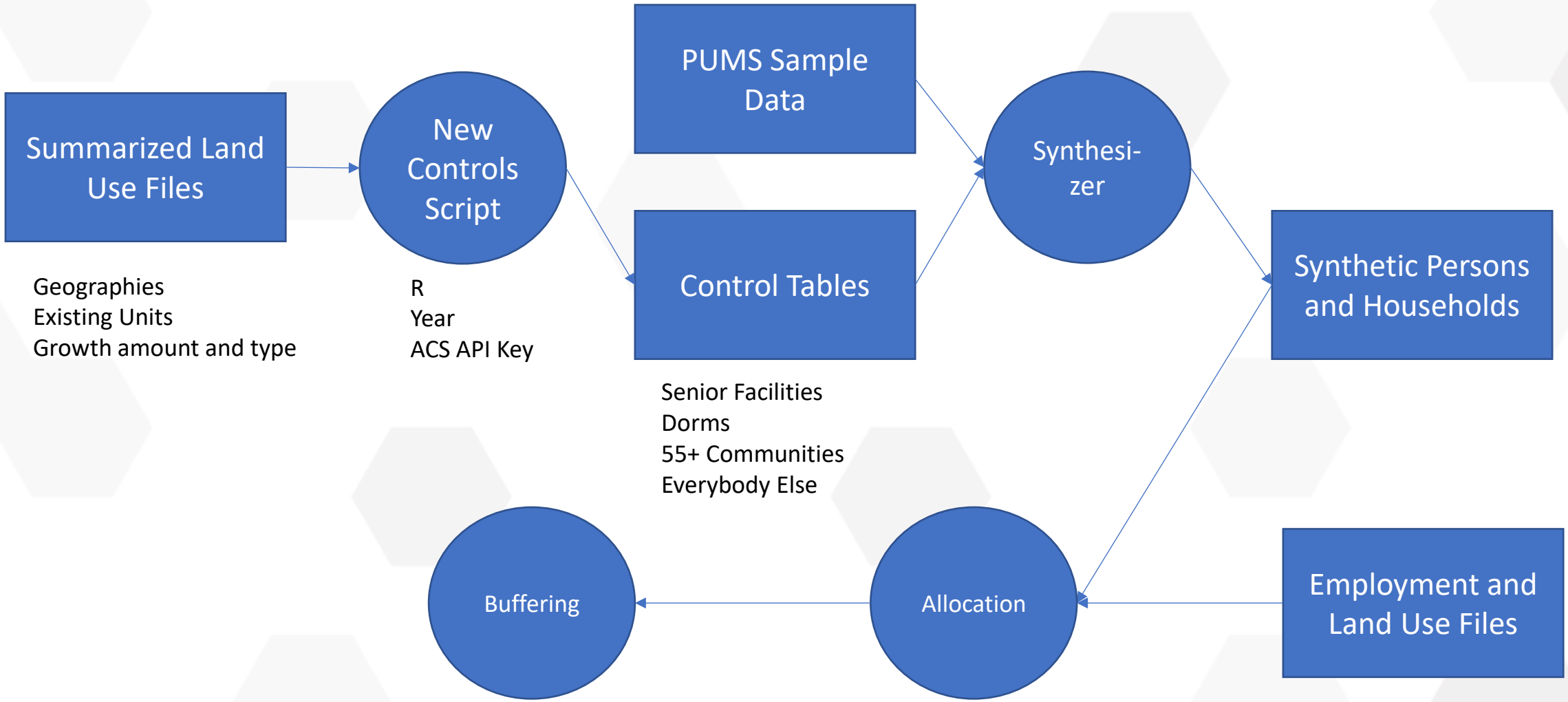
Base-Year vs Future Year Control Splits



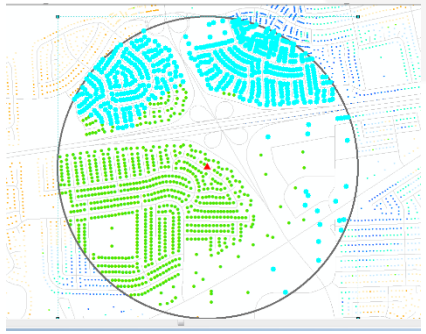
Base-Year vs Future Year Control Splits

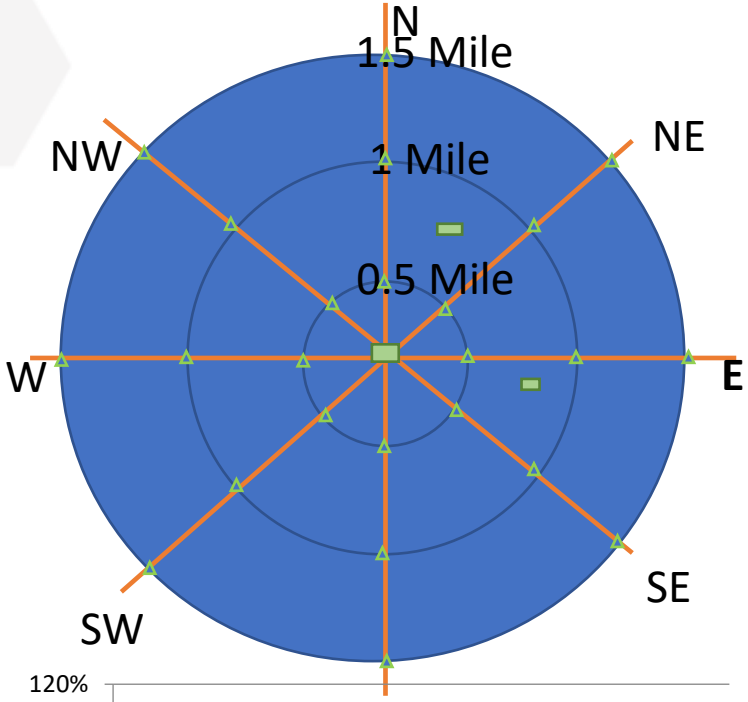


Land Use Update Process



Circuity Buffer

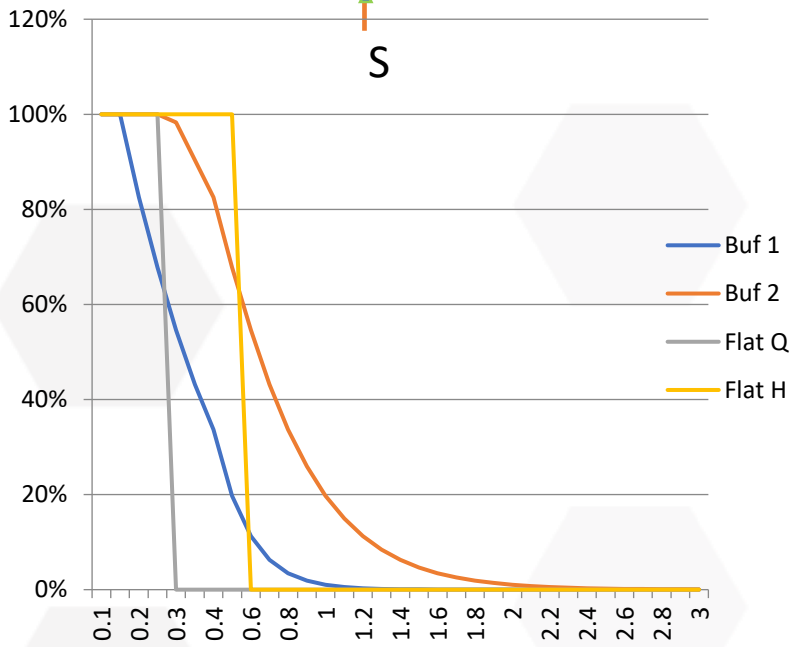




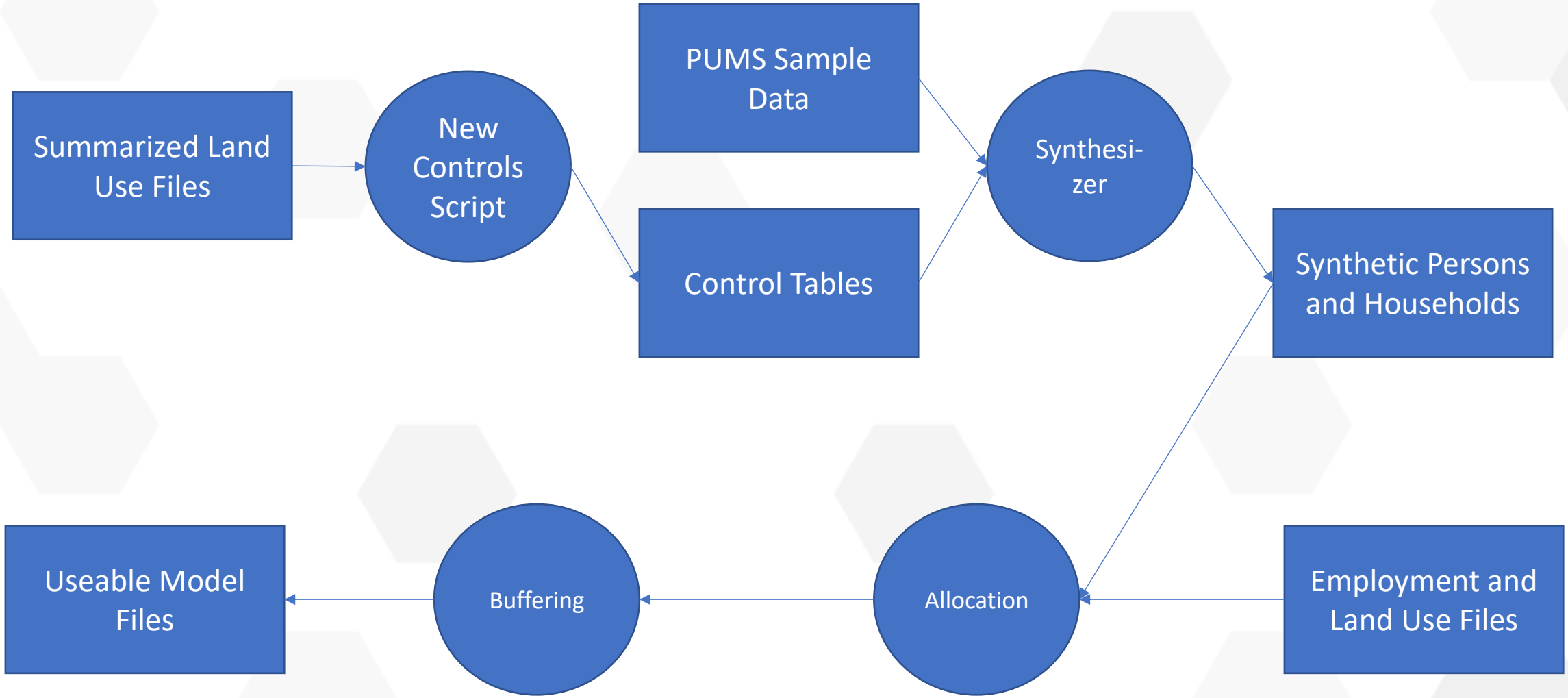
Circuity Ratio Concept

Compute circuity ratio
for 24 predefined points
Interpolate any other parcels

- Distance to:
  - Transit
  - Employment
  - Other households
  - Parks
- Especially important to re-buffer when updating transit!



Land Use Update Process



Questions?

Email: iitani@sacog.org

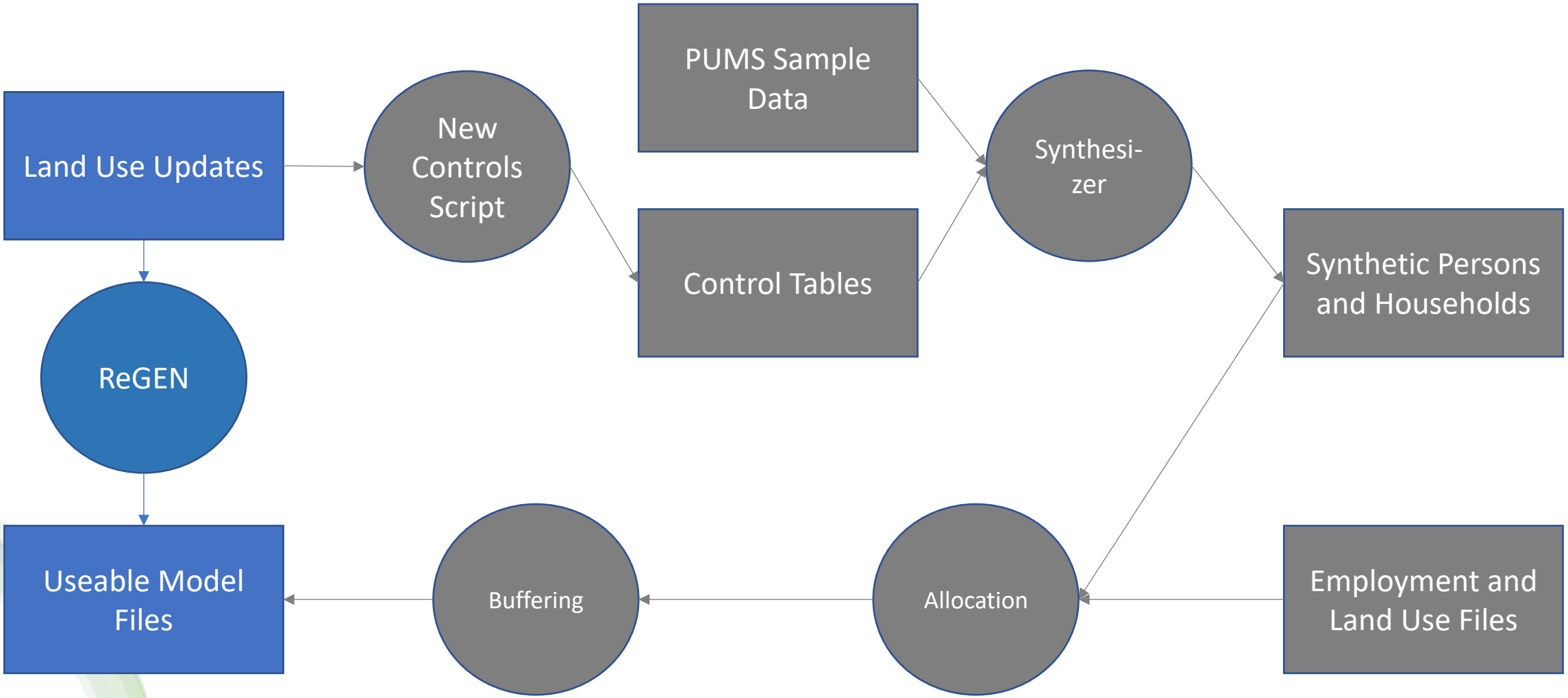
ReGEN

ReGENeration tool for regional land use and population files

What is ReGEN?

- ReGEN is a land use update tool.
- It regenerates model run files based on land use updates you can make directly on a map in GIS.
- It does not require extensive modeling experience.
- It is aimed at making land use updates quicker and less costly.

How Does ReGEN Work?



ReGEN vs PopulationSim

ReGEN

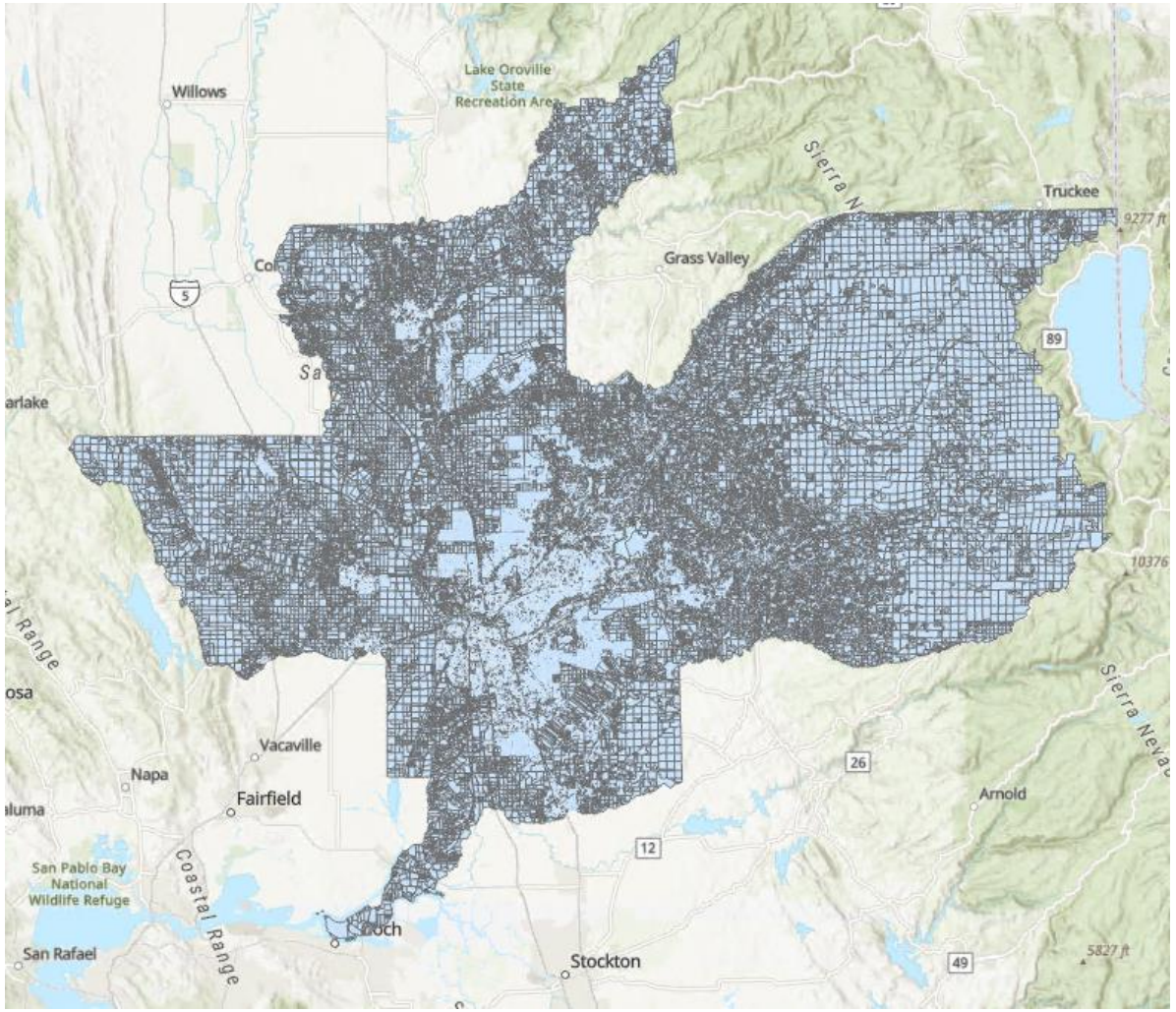
- Faster
- Surgical
- Simpler process
- Better for local changes
- Updates final run files only
- Limited customization

PopulationSim

- Slower
- Regionwide effects
- More complex process
- Better for regional changes
- Updates all intermediate files
- Very customizable

How Does ReGEN Work?

Select the parcels you want to modify



How Does ReGEN Work?

Update land use and employment information

SACOG Release
2 Households
0 Employment

ReGEN Run
200 Households
300 Employment

How Does ReGEN Work?

Setup the environment and ReGEN toggles

- The tool runs on R and needs some initial setup
- Modify toggles:
  - SACSIM Version
  - Year
  - Household total control
  - Person total control
  - Household size control

How Does ReGEN Work?

Running the tool

- Parcels with updates to dwelling units get populated with households and persons based on their community type, density and county.
- Parcels with updated employment also get modified.
- Buffering is integrated in the process.
- Ready to use model run files are outputted.

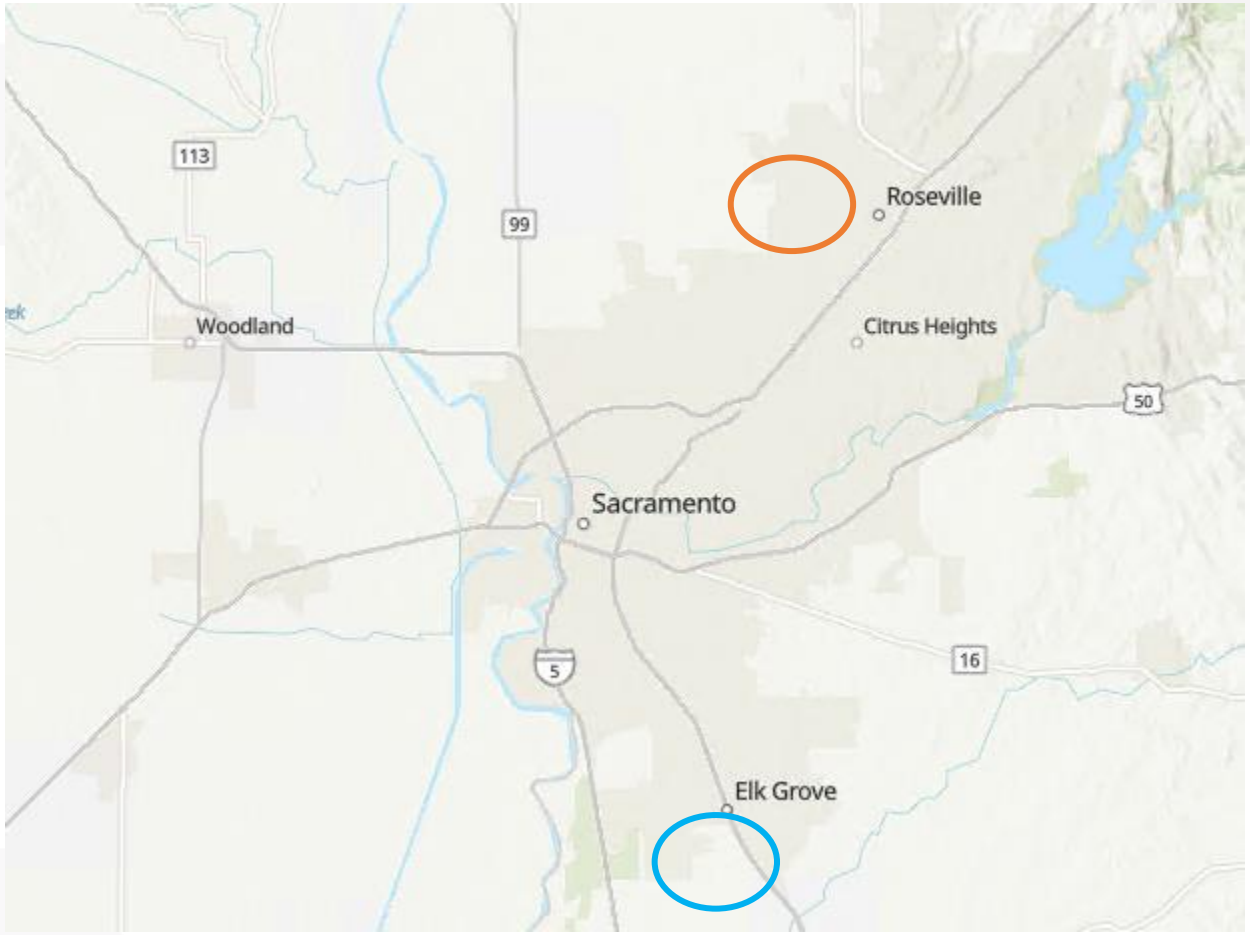
How Does ReGEN Work?

Running the tool

```
"Reading in the input files."
"Processing dwelling unit change."
"Sampling new households based on dwelling unit changes."
"Population control activated."
"Initiating population rebalancing. Reducing the number of persons."
"Population rebalancing complete."
"Processing newly sampled households and persons."
"Writing out new_raw_household.txt and new_raw_person.txt."
"Updating parcel file to be used in rebuffering."
"Writing out new_sacog_parcel.dbf to be used in buffering."
"Updating circuity factors needed for buffering."
"Writing out new_sacog_parcel_circuity.dat to be used in buffering."
"ReGEN run completed. Proceed to run buffering to obtain the new raw_parcel.txt file."
```

Test Case

Growth Reallocation

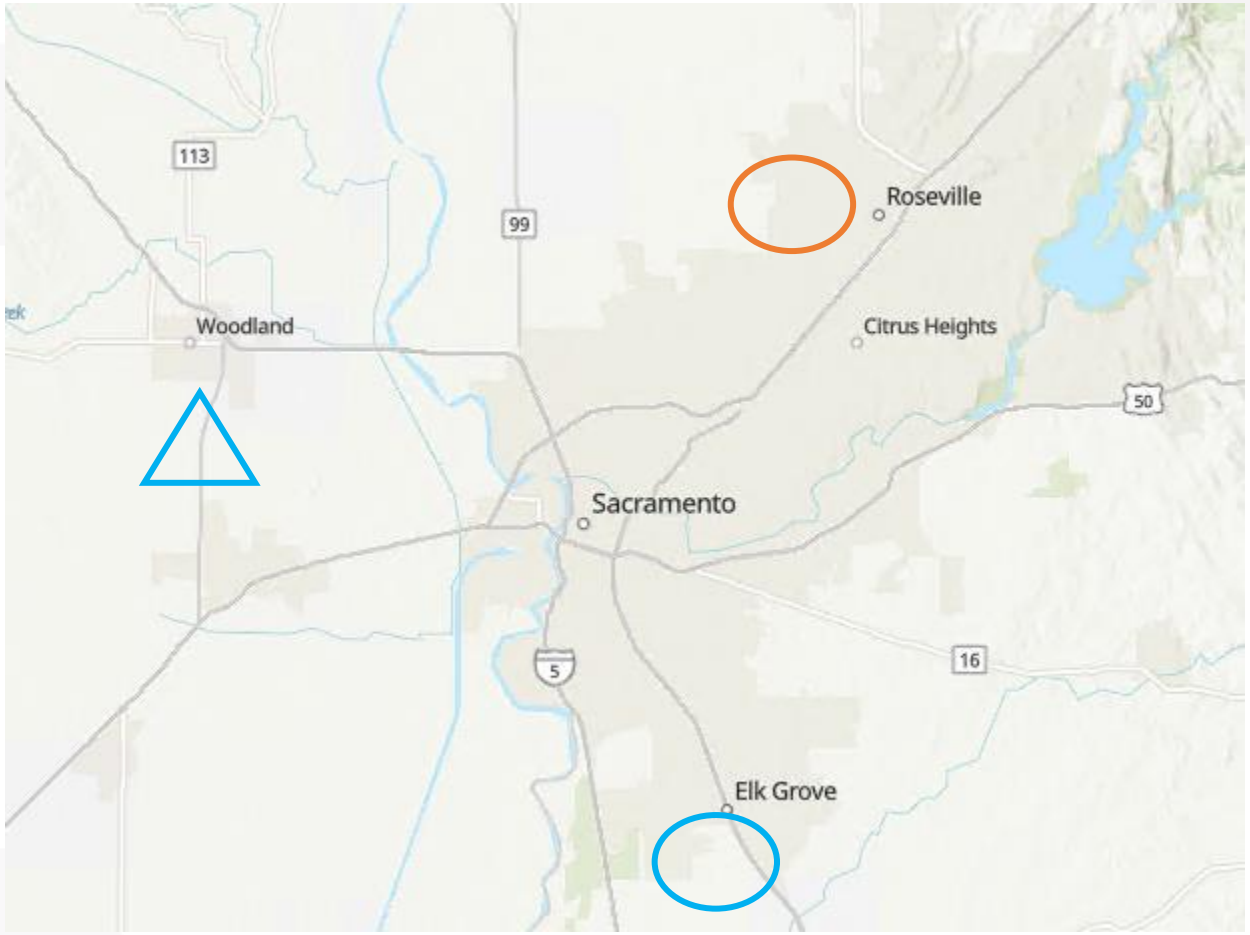


Decreased Dwelling Units

Increased Dwelling Units

Test Case

Employment Growth



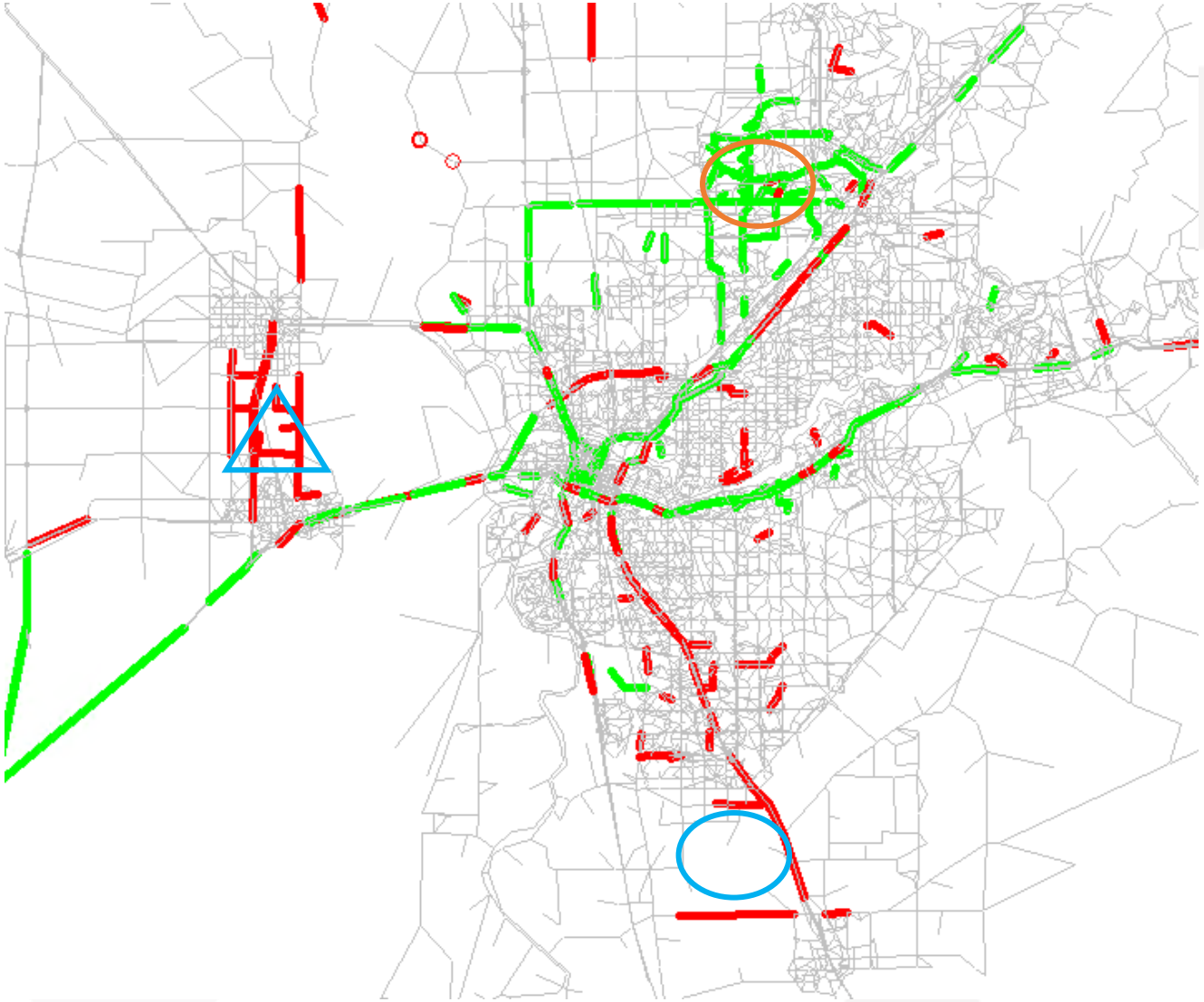
Decreased Dwelling Units

Increased Dwelling Units

Increased Employment

Test Case

Results



Decreased Dwelling Units

Increased Dwelling Units

Increased Employment

Increased Volume

Decreased Volume

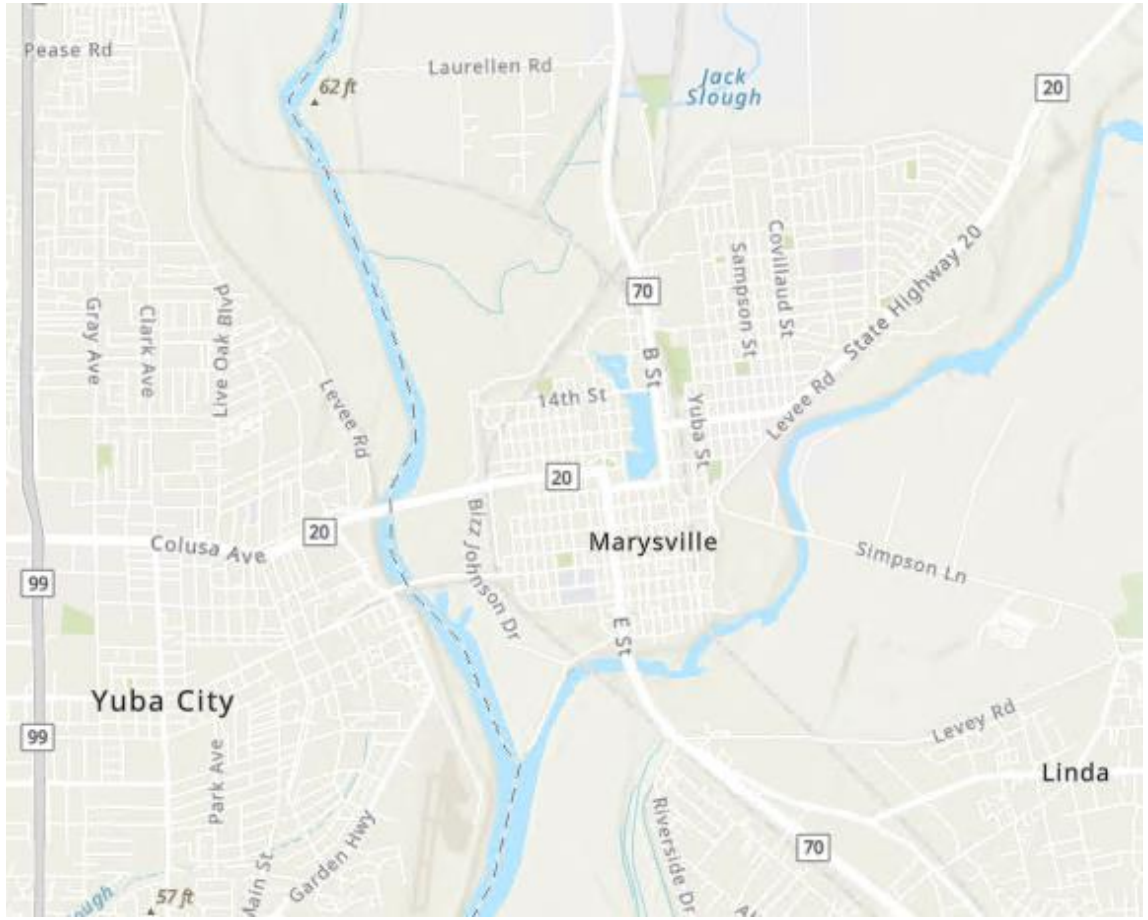
Possible Use-Cases

- General plan updates (example to follow)
- SB 743 VMT analysis
- Scenario testing

- Note:
  - This tool is not a replacement of the main modeling process
  - It is meant to be used for local-scale changes
  - It still requires an expert to determine and allocate the land use changes
  - It does not run the model or analyze results

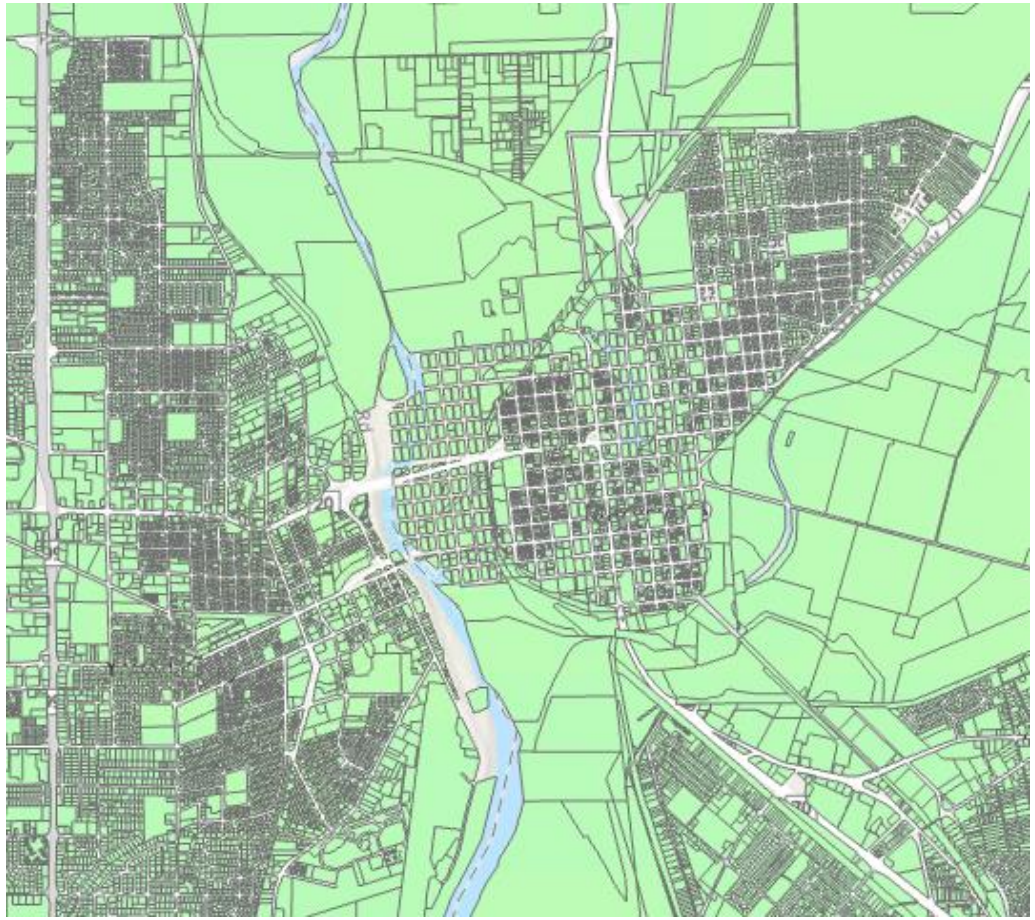
Marysville General Plan Update

Focus Area



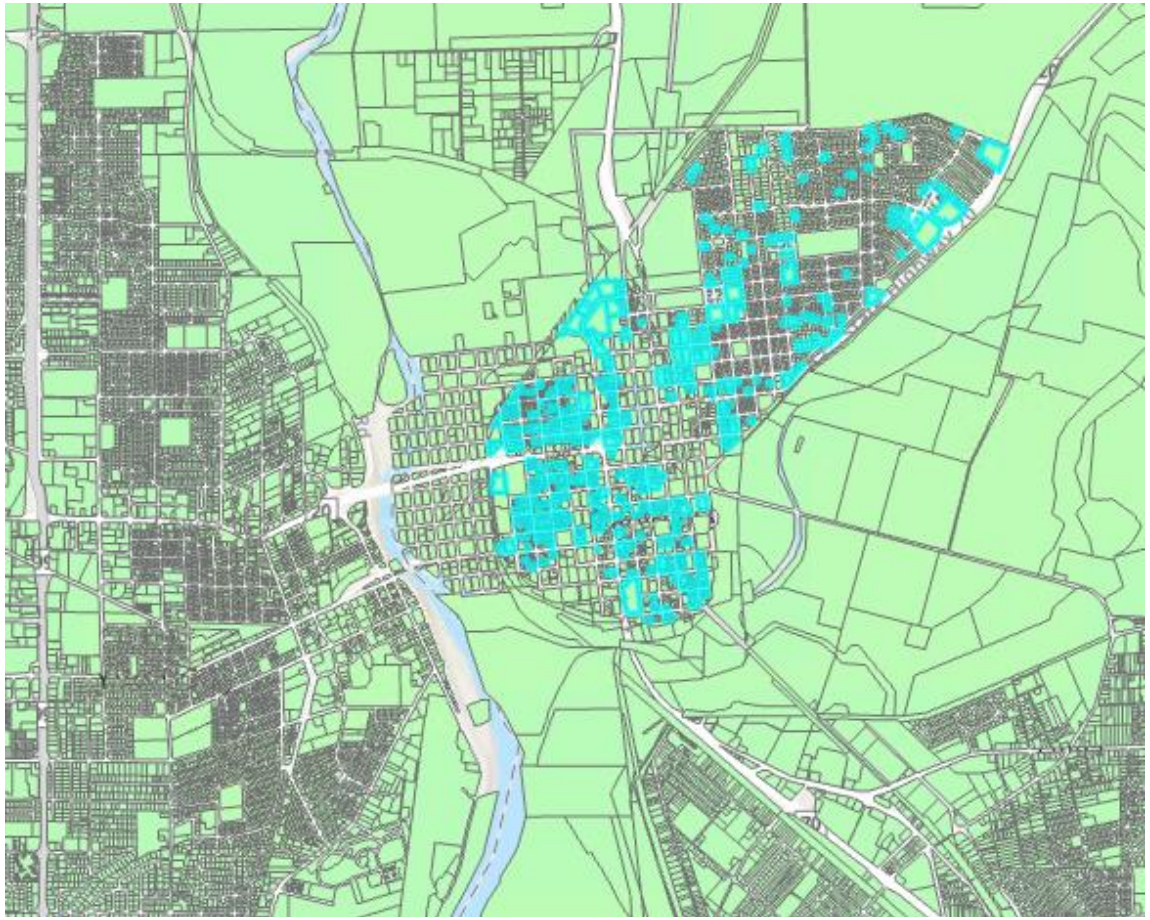
Marysville General Plan Update

Parcel File



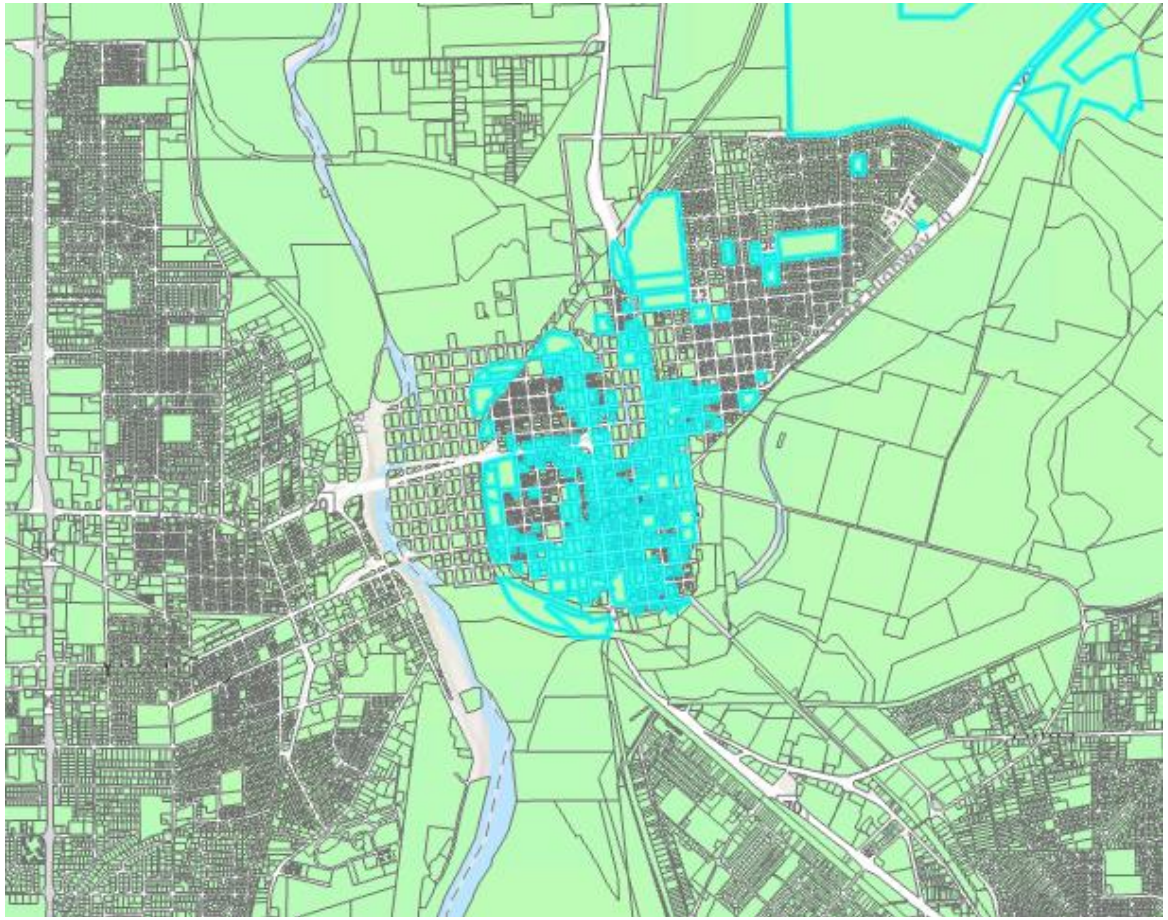
Marysville General Plan Update

Dwelling Unit Changes



Marysville General Plan Update

Employment Changes + Enrollment Updates



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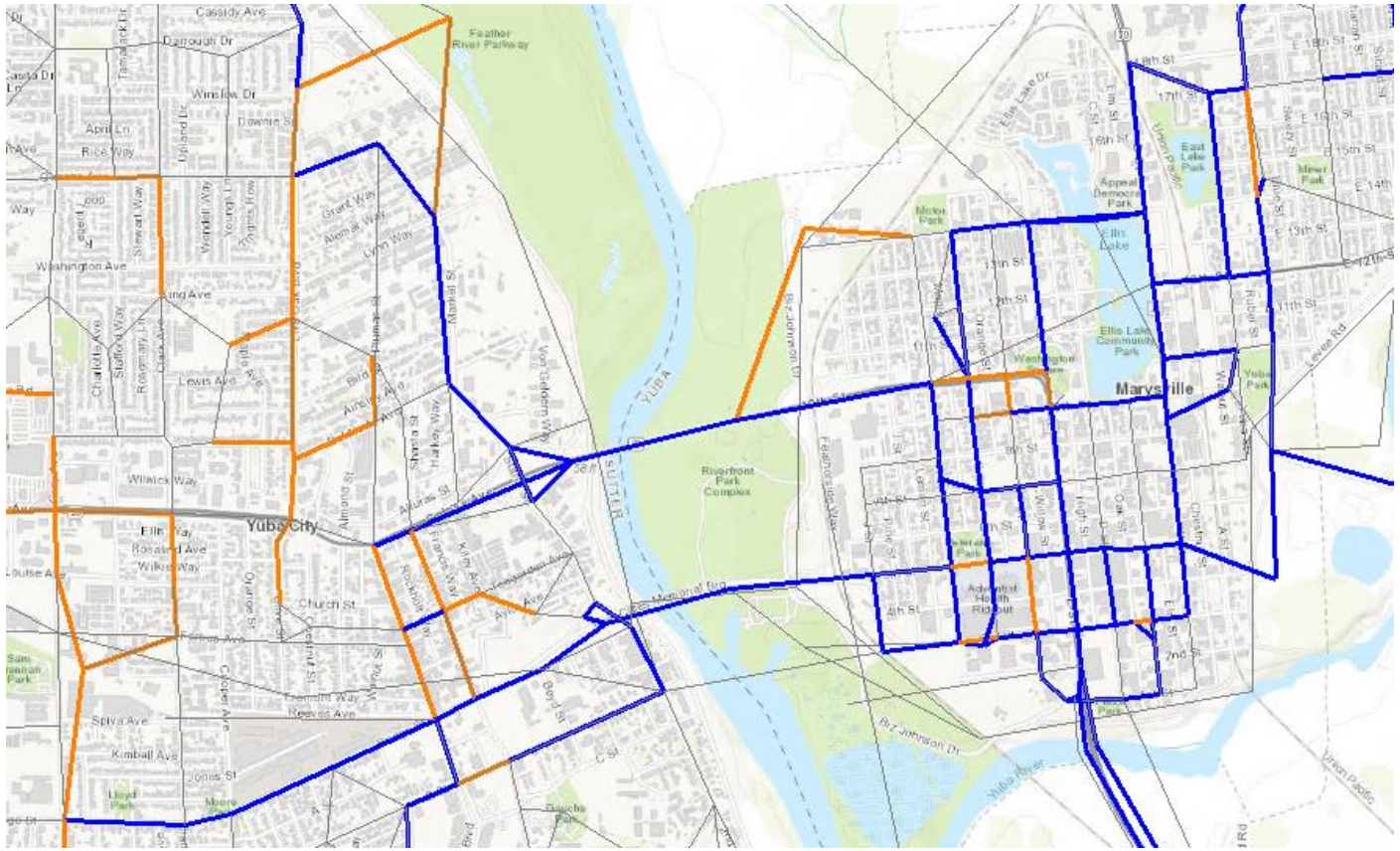
Volume Changes



Release

- Full process guide will be released later in the year.
- You can request trainings after the release.
- A beta-version of ReGEN will be released right after this conference.
- Please reach out if you are interested in testing and sending feedback.

Questions?

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